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frontispiece

A garden grows after the cleanup in Na Ngoo, Thailand. Below:
Busy children weave dish covers to protect food against insects.
Story of a village sanitation project appears on pages 715-719.

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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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PUBLIC HEALTH SERVICE

LEROY E. BURNEY, *Surgeon General*

This comprehensive account of the growing challenge of transportation hazards to health and safety strongly emphasizes the responsibility of both physician and public health officer in preventing accidental trauma.

Health and Safety in Transportation

ROSS A. McFARLAND, Ph.D.

THE ASSURANCE of health and safety in transportation has become one of the basic needs in modern life. In certain areas of the world, safety in transit is assuming even greater importance than problems relating to food, shelter, and clothing. In the United States, for example, extensive mechanization of the environment, diverse industrial procedures, and increasing use of transport vehicles have resulted in new threats to the well-being of large sections of the population.

The important role played by human variables in causing accidents brings the control of accidents within the province of preventive medicine and public health. The physician and the public health officer, with their broad training in the biological sciences, are especially qualified to improve safety in industry, in the home, and in various forms of transportation.

Efforts in the control of accidents can be

Dr. McFarland, who is professor of environmental health and safety at the Harvard School of Public Health and director of the Guggenheim Center for Aviation Health and Safety, is a prolific author on the subject of transportation safety. The paper was delivered in essentially the same form before the American College of Preventive Medicine in Cleveland, Ohio, on November 13, 1957. Many of the studies reported were sponsored by the Commission on Accidental Trauma of the Armed Forces Epidemiological Board, Department of Defense, and supported in part by funds from the Office of the Surgeon General, Department of the Army.

strengthened by the application of epidemiological techniques. The methods which have been used so effectively in the control of infectious disease can be broadened to prevent injuries, especially on the highway and in the air (1). Since most accidents have multiple causes, the interactions between the "host" (driver, pilot, or operator), the "agent" (vehicle, plane, and equipment), and the "environment" are important considerations in attempts at control. While the host factors are of particular interest to physicians, they must be viewed in their relationships to the agent and the environment for an adequate understanding of accident causation (2).

Because human variables are especially important in causing accidents, the physician or the public health officer has a direct responsibility in the prevention of injury. Moreover, since memory operates most effectively when reinforced by emotion, the physician is in an especially favorable position to teach while treating and to indoctrinate patients with the principles of accident prevention. It is thus of great importance for the physician to take the initiative in identifying the causes of accidents in order to institute preventive procedures (3).

Current approaches to the control of accidents may possibly be reaching the limits of their effectiveness. The next significant advances in safety may result from a combined approach which includes the engineering and

biological sciences. This collaboration is not new in medicine, and such an approach has been the basis of many important developments. For example, the control of malaria was achieved by cooperation between the entomologist, the sanitary engineer, and other specialists. The physiologist, the psychologist, the anthropologist, the engineer, and the physician can similarly cooperate to obtain basic data in order to achieve improved prevention of motor vehicle accidents (4).

Transportation Facts and Figures

A few examples of the extent to which passenger transportation has increased in modern times show the magnitude of the problem.

In 1956, buses, automobiles, taxis, and trucks, operated by 77 million licensed drivers, traveled some 630 billion miles on the highways in the United States. Drivers and passengers in automobiles and taxis alone accounted for 970 billion passenger-miles of travel; 51½ billion passenger-miles were recorded in intercity bus operations.

In aviation the volume and speed of travel have been increasing very rapidly. During the first 24 years of the air transportation industry, that is, up to 1950, 100 million revenue passengers were carried by scheduled domestic and international carriers in the United States. By 1957, 349 million revenue passengers had been carried. The number of revenue passengers on airlines of the United States in 1956 was about 46 million. These represented about 70 percent of the total world volume of 68 million revenue passengers on airlines. In 1956 for the first time more passengers were carried to Europe by air than by ocean liner, and 68 percent of all passenger traffic between the United States and other nations was by air. Helicopter scheduled airlines were nonexistent 5 years ago. In 1957, this new type of service carried 152,000 passengers (5, 6).

The transition from piston engines to jet propulsion will impose new and interesting problems in the next few years. Approximately 350 jet transports are now on order. These planes will carry as many as 140 passengers each at a cruising speed of approximately 600 miles per hour.

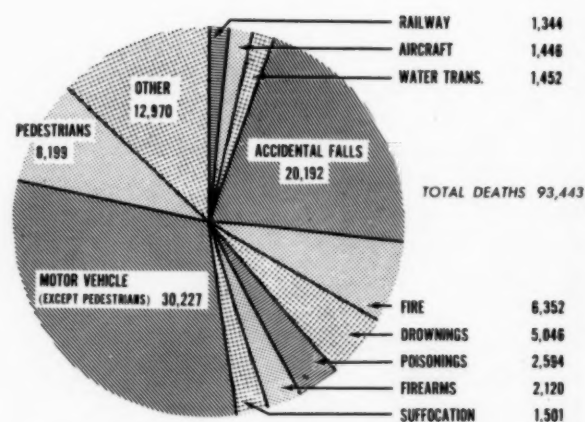
The number of revenue passengers using the railways exceeds 400 million per year, excluding commuters. Also, in 1956, more than 9 billion separate fares were paid by local transit riders.

It is now apparent that almost everyone uses some mode of travel or another, not once, but many times during the course of the year. The exposure of our populations to travel hazards has reached enormous proportions both in relation to accidental injury and the threat of exposure to certain diseases.

The frequency of accidents now presents a major problem. Each year approximately 95,000 persons are killed in various kinds of accidents in the United States (fig. 1). About 350,000 others receive permanently disabling injuries, and temporary disabilities severe enough to keep them away from work for at least a day are incurred by 9½ million persons. These accidents occur mainly in the home, on the job, and during transit. Accidents in various forms of transportation, particularly on the highway, have reached epidemic proportions. Since the invention of the automobile there have been more than a million fatalities in motor vehicle accidents in the United States; in 1957, highway accidents accounted for 41 percent of all accidental deaths. The annual direct costs of traffic accidents approximate 2 percent of the national income (7, 8).

Fatal accidents involving persons under 35 years of age formed a large proportion of the

Figure 1. Accidental deaths in the United States during 1955.



SOURCE: Reference 7.

total deaths in highway accidents. This implies an enormous drain on the productive resources of the country. Accidents are the leading cause of death for persons between 1 and 34. They are exceeded only by heart disease and cancer for those between 35 and 44 years of age (9).

In the armed services, accidental trauma is now a major problem. During World War II the United States Army reported more deaths among its soldiers caused by accidents than by disease for the first time in its history. In the Korean conflict more than half of the hospitalized casualties resulted from accidents rather than from enemy action. Of these, 70 percent were incurred in motor vehicle accidents (1). The frequency of motor vehicle accidents in all three branches of the Armed Forces has become very serious, and accidents now exceed upper respiratory infections and rank first as the leading cause of man-days lost. Motor vehicle accidents account for about 2,100 fatalities of servicemen each year, a large majority occurring while personnel are off duty (10).

The integration of motor vehicles into our way of life has become very costly in fatalities, injuries, and damaged equipment. In spite of the enormous increase in volume of highway traffic, there has been a significant decrease in accident rates during the past 25 years. For example, in 1957 the fatality rate per 100 million miles of travel was only 5.9, in comparison with the rate of approximately 15 about 20 years ago. Nevertheless, the actual number of persons killed or disabled and resulting costs to the Nation's economy have increased from year to year with only a few exceptions apart from the period of restricted travel during World War II. In 1957 there were approximately 38,500 deaths and 1,350,000 injuries disabling beyond the day of the accident (7). According to present trends, it is estimated that 1 of every 10 persons in the country will be injured or killed in a traffic accident during the next 15 years (8).

The safety record of scheduled airlines in the United States is an enviable one in relation to the exposure. Only 154 fatalities were reported for 1956, with the 128 deaths in the Grand Canyon accident accounting for approximately five-sixths of this total (5). In 1957,

there were 31 deaths. Business flying is reasonably safe, but private flying has a relatively poor record. There were 655 fatalities in 1956 in 3,411 accidents among 65,000 business and private planes. Thus, 1 in about every 19 of these airplanes was involved in an accident. Crop dusting by airplanes, of great importance to both public health and agriculture, is also hazardous. Military flying obviously involves increased hazards. However, in United States naval aviation there is now only about one fatality per day. For example, in 1956, there were 413 deaths attributable to aviation accidents (11). In the U. S. Air Force, with its far more extensive operations, deaths have been reduced to about three per flying day (12). In 1955, there were 825 fatalities.

To determine precisely the relative safety of different kinds of transportation is impossible because of the lack of a satisfactory common denominator for a valid comparison. The nature and frequency of the hazards encountered differ greatly among the various forms of transport, as does the number of passengers exposed to danger of injury in the different types of vehicles (13).

At present, death and injury rates per 100 million passenger-miles are used in estimating the safety of travel, and, on this basis, table 1 shows the accident death rates in passenger transportation (5, 7). While deaths per 100 million passenger-miles is not a wholly satisfactory basis for this comparison, it appears that on the whole buses and trains have the lowest rates. Those for automobiles and taxis are much higher, and air transportation occupies a

Table 1. Accidental deaths of passengers per 100 million passenger-miles in United States transportation, 1947-56

Type of carrier	1947-51 average	1952	1953-55 average	1956
Scheduled air transport:				
Domestic	1. 6	0. 37	0. 49	0. 64
International	1. 1	2. 98	. 03	. 17
Railroad passenger				
trains .....	. 27	. 04	. 10	. 20
Intercity buses .....	. 19	. 16	. 14	. 16
Automobiles and taxis ..	2. 2	2. 8	2. 7	2. 7

SOURCE: References 5 and 7.

middle position, slightly above those for trains and buses. Actually, the accident frequency rates for air transportation are quite low; the fatality rates reflect chiefly the fact that there are few survivors in the major accidents.

Epidemiological Approach

A basic step in the application of the epidemiological approach is determining the fundamental physical, physiological, and psychological characteristics of the host. When these data are correlated with the characteristics of the agent (vehicles and equipment) under specific environmental conditions, the resulting information will shed light on the causes of accidents and aid in developing preventive measures. To obtain this kind of information experimental and clinical studies, epidemiological surveys, and careful statistical analysis are required (3).

An epidemiological approach to highway safety in the armed services was applied in a recent study sponsored by the Commission on Accidental Trauma of the Armed Forces Epidemiological Board. About 88 percent of highway accidents in the Navy and Marine Corps occur while the personnel are off duty. The epidemiological method was used to study this problem at a major Marine Corps base.

It was previously supposed that the main problem concerned fatal accidents during weekend periods on considerably long automobile trips. The study showed, however, that 96 percent of the accidents occurred within a 50-mile radius of the base, and 71 percent within 10 miles. The greatest percentage of accidents occurred between 6 p.m. and midnight, that is, during the evening recreation period. The analysis identified the young, unmarried enlisted men of low rank who live on the base in Government quarters as having a highly disproportionate share of the accidents. These findings have formed the basis for a new accident control program at this military installation (10).

It will not be possible to present a complete analysis of the epidemiological approach in both the highway and air transport fields, and primary emphasis will be given to the findings relating to highway safety. However, there are

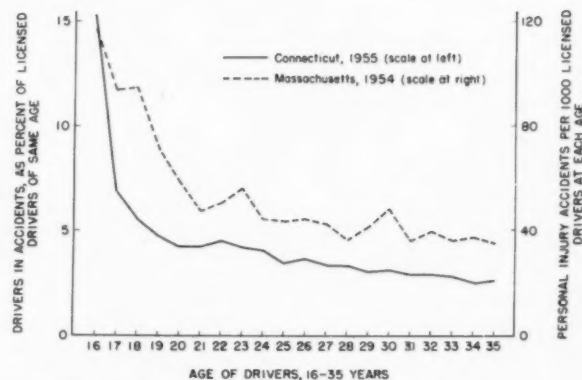
several interesting problems in the field of air transportation which have far-reaching implications for the health and safety of large sections of the population, and a few of these will be singled out for special mention. The first one concerns the medical care of the flight crews and the handling of problem medical cases. This will be considered in the discussion of host factors. The second refers to the possibility of spreading disease by aircraft, which will be treated under the heading of host-agent factors in health and safety. The third involves host-environment relationships in connection with the transportation of patients by air, and the problems which may arise from a loss of pressure in pressurized air transports.

Host Factors in Accidents

Thus far no single characteristic of drivers has been identified which accounts for a large proportion of accidents on the highway. This is true for a variety of sensory, psychomotor, and psychological investigations (8, 14). A few useful generalizations may be made, however, about driver characteristics in relation to accidents.

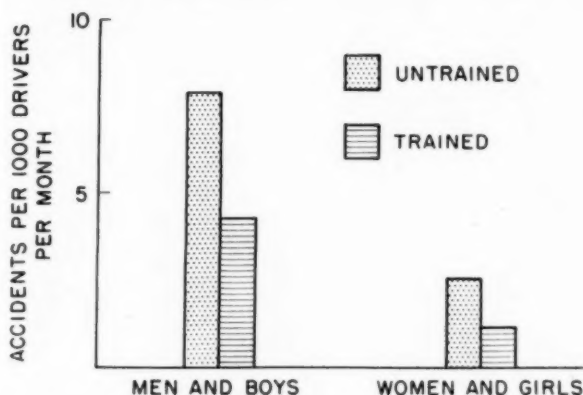
Results of a number of studies clearly indicate that, in relation to their numbers, drivers up to the age of about 25 have accidents more frequently than do those from 30 through 60 or 65 years of age. The most recent and complete information, from Massachusetts and Connecticut, indicates the highest rates for the

Figure 2. Frequency of accidents among drivers aged 16 to 35, based on Connecticut and Massachusetts experiences.



SOURCE: References 15 and 16.

Figure 3. The safety record of trained drivers compared with that of untrained, based on 1,226 accidents during an exposure of 300,536 driver-months.



SOURCE: References 8 and 17.

youngest drivers, those of age 16. The rate decreases with succeeding years of age, rapidly at first and then more slowly (fig. 2). It levels off at about age 30 and remains stable and relatively low through age 65 (15, 16). Data related to ages above 65 are as yet too meager for interpretation. The factors responsible for the higher rates for youthful drivers are believed related to inexperience and to psychological characteristics of youth in the adolescent and early adult phases of adjustment (8).

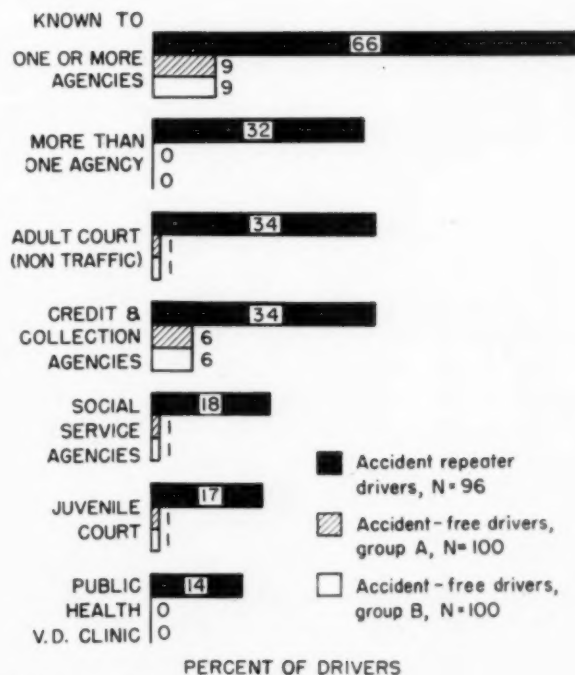
In the United States, roughly 10,000, or about half, of the high schools in the country offer classroom instruction in highway safety and training in the operation of automobiles. A number of studies have been made on the effectiveness of this training. The results, shown in figure 3, agree substantially that the accident rates of trained drivers are about half as high as those of untrained, at least during the first few years of driving (17). Many of the reports also indicate fewer violations of traffic regulations by trained drivers. It is also apparent that classroom instruction alone is less effective than a combination of classroom instruction and behind-the-wheel training. It thus appears that the adequate initial training of drivers constitutes an important method of reducing accidents in a portion of the driving population presently characterized by the highest rates. There is still the need, however, for research on what should be taught, on ways

to provide training in driving under adverse conditions and in the handling of emergency situations, and on ways to expand training programs to include all beginning drivers (8).

Of the greatest importance in driving safety are the attitudes and personal adjustments of drivers. A useful concept which has been developed in this area is that "a man drives as he lives." Studies of accident repeaters and accident-free drivers carried out in Canada showed that maladjustments in meeting the personal and social demands of living were far more frequent among the accident repeaters than among accident-free groups. A promising method for the identification of accident-repeater drivers resulted from this study (18). It was found that, as a group, the accident repeaters could be differentiated from the accident-free drivers on the basis of the number of contacts with such agencies as the civil and criminal courts, collection agencies, public health clinics, and social welfare agencies (fig. 4).

The same procedure was subsequently ap-

Figure 4. Personal and social adjustments of accident repeaters and accident-free drivers matched for geographic location and driving experience.



SOURCE: Reference 18.

plied to a large sample of truck drivers in a study at Harvard. Accident-repeater and accident-free drivers were carefully matched to meet rigid standards, and various public records were searched for their names. Findings very similar to those in the Canadian study were obtained. A statistical analysis by the chi-square technique was made to determine the relative usefulness of the various indexes of antisocial or maladjustment tendencies in differentiating those with repeated accidents from those without accidents. The relative value of selected items in discriminating between accident-free and accident-repeater drivers has been developed in the following manner:

Item	Chi-square
Court record of automobile offenses-----	7.48
Minor violation in motor vehicle records-----	6.76
Court record of offenses against persons-----	6.43
Unfavorable business inspection report-----	3.84
Court record of offenses against self-----	2.55
Court record of offenses against property-----	2.01

The values for the individual items having greatest significance were applied as weights to the information obtained on a new sample of unselected drivers. In this preliminary experiment the procedure identified the accident repeaters in the sample with an accuracy of 85 percent (19).

In another study information from the service records of 210 military pilots who had been killed in noncombat aircraft accidents was compared with records of a 20 percent sample of reserve pilots discharged after satisfactory service (personal communication). A record of disciplinary charges was found for 48 percent of the fatal accident group as against 31 percent of the control group. "Violation of flying orders" was the most discriminative type of offense—21 percent of the fatal accident group as against only 2 percent of the controls. Nonflying disciplinary infractions were also significantly different in the two groups, the accident group rating higher in resistance to order and discipline. Also noted in the accident group were the larger proportion of pilots who had not completed high school and the larger proportion of pilots who changed jobs frequently prior to enlistment.

An intensive investigation of personality factors in relation to accidents is currently being

made at the University of Colorado. This approach includes extensive psychological testing and intensive psychiatric evaluation. One group test—a modified form of the Allport-Vernon Scale of Values—has provided a 70 percent accurate discrimination between no-accident drivers and those with a high-accident record. Characteristically, and in contrast with the accident-free, those drivers who have had accidents scored high on the theoretical and aesthetic scales and low on religious values. Through a combination of the test results and the clinical material, it appears that the accident-prone driver is less likely to identify himself with the father, more likely to consider authority figures unpleasant, and more likely to show an excess of regressive, masochistic fantasy. The most useful tests are now being given to all of the high school students in the city of Denver. The results will be correlated with their subsequent driving records (10).

In situations involving time stress and complex reactions, the lower accident rate for adult and middle-aged drivers is clear, but for persons past middle age there is some evidence that the rate may increase. It is known that reaction times tend to become longer with advancing age, and impairment in the efficiency of all the senses occurs. Many persons, however, develop compensating habits offsetting these losses. It is believed, for example, that older drivers tend to drive slower and to do less driving at night.

Research carried out at Cambridge University on the effects of aging on skilled performances has suggested the kinds of situations in which aging persons might be especially vulnerable to accidents. The implication is that when an older driver is required to assimilate a novel or complex situation instantaneously, and to carry out a rapid sequence of reactions, he is apt to become confused and make errors. Without time pressure and in familiar situations, a more adequate or efficient response can be expected (13, 20).

Many accidents occur when the efficiency of the driver is impaired by some temporary condition. The efficiency and safety of driving may be adversely influenced by a variety of temporary states, although, in general, statistical

proof of the importance of a given type of condition may be very difficult to obtain. For example, the role of fatigue in asleep-at-the-wheel accidents appears quite clear, but fatigue may be a more subtle factor in many other accidents. When drivers are emotionally upset or preoccupied with personal problems, alertness to the driving situation may be diminished. Alcohol is widely cited as a cause of accidents. And what may be the influence of concurrent disease or of various abnormal physical conditions? Also, is safety compromised as a result of either the direct or side effects of various drugs and remedies taken for a variety of medicinal purposes (8, 14)? The following are several of the findings concerning the influence of temporary conditions.

Driver fatigue is not only related to the length of time spent in driving. Consideration also must be given to such factors as amount and quality of previous rest, the nature of activities prior to driving, and concurrent emotional stress. In addition to the subtle disorganization of skill which develops with increasing fatigue, drivers when extremely tired may experience hallucinations of obstacles on the highway, and a number of accidents have been traced to actions taken by drivers to avoid collision with these imagined barriers. When interviewed confidentially, more than half of a sample of professional drivers engaged in long-trip driving admitted having had such experiences (19).

Driving skill is adversely influenced in many with as little alcohol in the blood as 0.03 and 0.04 percent. The likelihood of an accident increases constantly as the alcohol in the blood increases from the lowest levels (8, 14). The risk at 0.10 percent is estimated to be more than twice that at 0.05 percent, while the risk at 0.15 percent appears about tenfold (table 2). These data are from a recent study in Canada (21). Additional data from the same study (22) show that as the level of blood alcohol increases, there is an increase in driving errors which result in accidents. In several series of autopsies recently made on drivers killed in accidents in the United States, significant amounts of alcohol were found in the blood and brain fluids of more than half of the cases.

A physiological fact which may have special

importance is that, while initially there is a close correspondence between the levels of blood alcohol and brain alcohol, the alcohol is eliminated more slowly from the fluids surrounding the brain than from the blood. Thus, elevated concentrations of alcohol may be found in the spinal fluid for some time after blood values have become negligible (13).

Through control of problem medical cases preventive medicine has an important role in reducing accidents on the highway and in the air. The questions of physical fitness to drive and the influence of pathological processes in accidents are of particular interest to physicians.

Most authorities would agree that epileptics, diabetics requiring insulin, and those with certain heart conditions should not operate public highway conveyances or pilot airliners because of the hazard of a sudden loss of consciousness. But what of the influence of such conditions in the general driving public and what cutoff points should be kept in mind? There are, for example, about 6 million truck drivers in the United States, yet it is known that only a small proportion of them receive thorough physical examinations, and that the development of adequate medical programs for the large number of workers in the transport industry remains to be accomplished. It would be expected that in this occupational group, a certain number use insulin, experience temporary impairments of consciousness, or have fairly advanced heart disease of one form or another (8, 19).

In the interest of prevention, does not the

Table 2. Accident hazard in relation to blood alcohol

Percent of alcohol in blood	Percent of accident drivers (N=432)	Percent of drivers not in accidents ¹ (N=2,015)	Ratio of accident drivers to non-accident drivers	Relative accident hazard
0.0-0.05-----	77.5	91.3	0.85	1
0.05-0.10-----	7.1	5.4	1.31	1.5
0.10-0.15-----	4.0	1.9	2.1	2.5
0.15 and over---	11.3	1.4	8.1	9.7

¹ Drivers not involved, but passing the accident scene shortly after the accident.

SOURCE: Reference 21.

physician have a responsibility to indoctrinate the patient and the public regarding the influence of disease on driving and the effects on human behavior and efficiency of prescriptions and medications employed? Within the patient-physician relationship, must not the cardiologist, for example, estimate the likelihood of sudden loss of consciousness in various forms of heart disease and advise his patients whether it is safe to drive? In this connection, what advice should the physician give his diabetic patient? Or how is safety compromised when with advancing age changes in sensory functions and reaction time can no longer be compensated by training and experience? How can the patient-physician relationship be reconciled with the physician's responsibility for the prevention of injury when there is a question of public safety?

Unfortunately, there are few controlled experimental data available to determine precisely the role of various clinical conditions in highway safety, or to establish medical criteria and cutoff points concerning fitness to drive. Conditions involving a sudden loss of consciousness provide the most dramatic illustrations of the influence of disease in accidents. For example, in England the incidence of coronary thrombosis over a 5-year period was studied among the bus drivers of the London Transport Executive. There were 133 cases. Six prompt fatalities occurred while the driver was at the controls of a bus. Three of these resulted in accidents. In the other three attacks, the operator was able to stop the vehicle without harm (23).

The need for research to evaluate the influence of specific conditions in traffic accidents and to establish critical cutoff points is very great, and physicians obviously can make important contributions in this regard. The limitation on driving for persons with various illnesses or disabilities presents a serious problem. The American public, moreover, does not readily accept limitations on personal freedom. An arbitrary prohibition of driving for all those afflicted with certain conditions would be needlessly restrictive and unfair to many persons, and cooperation between the medical profession and the motor vehicle authorities in handling these problems on an individual basis is essential. Several studies have shown that

drivers with quite severe physical limitations may have safe records if they are carefully supervised by their physicians. In Massachusetts, for example, a satisfactory safety record has been found with certain high-risk drivers permitted to hold licenses and drive under a program of continuing medical surveillance. These drivers include persons with such disabilities as epilepsy, diabetes, multiple sclerosis, and various amputations and paralyzes (8).

If the problem of medical fitness to drive is to be satisfactorily worked out, large-scale studies of persons with various disabilities must be carried out to let them help decide which of this group should not drive. For example, a physiological and clinical study of 1,000 diabetics, together with statements from them about critical incidents and episodes and how they have been influenced in a dangerous way, would supply needed information in this area. Such a study might prove a more acceptable approach than the setting of arbitrary cutoff points without an experimental basis. A study of this type is at present being carried out at the Harvard School of Public Health.

In the field of air transportation, airline pilots receive periodic physical examinations through designated medical examiners of the Civil Aeronautics Administration. A few of the 80 airlines of the world have good medical departments, but less than one-fifth of the scheduled airlines have formal medical organizations. The report that each month, for a 5-month period in 1957, a pilot on active duty died while in the cockpit will emphasize the importance of continuing medical supervision, as well as of the value of having a co-pilot. One of the pressing problems in this area relates to the changing age distribution of airline pilots. With many of these men now entering age groups beyond 45 and 50, many problems of health and safety may be anticipated (24).

The findings for 232 problem medical cases among transport pilots have been followed through a period of 20 years. Permanent grounding resulted in only 83 cases, all of the others having returned to duty (13). The majority of cases were classified as neuropsychiatric and cardiovascular. Such studies are of great value in the delineation of cutoff points

for airline pilots, and, furthermore, they do not support the belief held by many pilots that a serious illness necessarily results in permanent grounding.

Host-Agent Relationships

A number of findings concerning transport health and safety relate to interactions between the host and agent. In the vehicular field host-agent relationships are primarily concerned with the effective integration of the man-machine combination. In order to promote that integration, automotive equipment should be designed with regard to human capacities and limitations.

Mechanical design should be intimately related to the biological and psychological characteristics of the driver. It is reasonable to expect, therefore, that machines should be designed from the man outward, with instruments and controls considered as extensions of his nervous system and appendages. This implies that the automobile should be built around the operator, with due regard for his requirements and capacities. When this is done there should be fewer accidents and no extensive redesigning of equipment after it is put into use (25), but until this is done, it is hardly fair to attribute so many accidents to human failures.

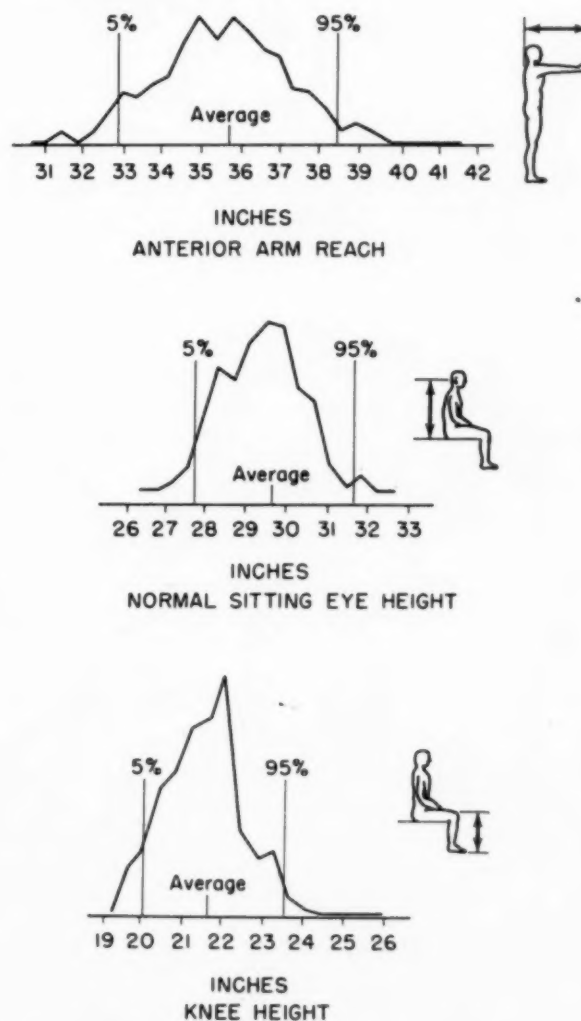
In general, any control lever that is unnecessarily difficult to reach and operate, any instrument that is difficult to read, any seat that induces poor posture or discomfort, or any unnecessary obstruction to vision may contribute directly to an accident. In addition, the cumulative effects of such difficulties lead to fatigue, to the deterioration of driver efficiency, and perhaps, eventually, to an accident (25, 26).

Numerous examples of faulty design in modern vehicles may be found from the standpoint of the range in body size of the drivers, the biomechanics of human movements and postures, and the characteristics and limits of human perception. A few examples are taken from a study at Harvard in which a number of current-model trucks were evaluated (19, 27). A common defect was insufficient range of adjustability in the seat, either horizontally or vertically. Again, important controls were often placed too far away. For example, in

one model only 5 percent of the drivers could reach and operate the handbrake from the normal driving position.

Clearances were frequently inadequate; in one model only the shortest 40 percent of drivers could get the knee under the steering wheel when raising the foot to the brake pedal. In another, this clearance was so small and the gear shift was so close to the steering wheel that the tallest 15 percent of drivers could not raise the foot to the brake pedal, by angling the knee out to the side of the wheel, without first shifting the gear lever away to the right. Figure 5 shows the distribution among truck and

Figure 5. Variations among approximately 400 truck and bus drivers in body-size dimensions important in driving.



SOURCE: Reference 28.

bus drivers of three body dimensions important in driving, to illustrate the kind of information that may be used in designing to "fit" the drivers (28).

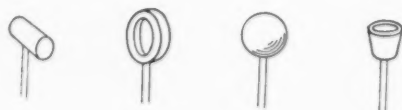
Inadequate vision from motor vehicles constituted a common problem, especially for the perception to the side and to the rear. Within the car or truck, instruments were frequently designed or placed so that they could not be read accurately and rapidly. Knobs and switches were sometimes identical in design and could not be distinguished from each other readily. Often they were so located that they could be operated inadvertently or by mistake. For example, a driver of one make of automobile had a serious accident while traveling at high speed during the night when he inadvertently shut off his headlights with the belief that he was pushing the knob for the cigarette lighter. Many examples illustrating such errors in design are found in the reports from studies carried out by the Harvard School of Public Health (19, 27, 28).



Baker and Grether (29) have demonstrated visually the principle of designing dials so that they can be read accurately and rapidly. Shown are 3 dials, 2 of which require the operator to interpolate between numbers on the scale. The third gives the necessary functional information at a glance.

Examples of the way in which knobs and handles can be shape coded to prevent the inadvertent operation of controls through mistaken identity have been developed by Jenkins and Sleight (30). Accurate visual discrimina-

Touch



Visual



tion can also be made when there is good color or contrast with the background.

Certain design features are especially important as causes of injuries to drivers and passengers in crashes. It is recognized that the crash and impact forces of a large proportion of fatal automobile accidents were actually within the body's physiological limits of survival, if the momentum of the body had been properly checked and the forces dissipated. A large-scale study of injury in relation to the structural features of cars and the circumstances is now based on the analysis of 8,000 cases per year (10). This study was initiated at the Cornell Medical College by the Commission on Accidental Trauma and has received substantial additional grants from two of the major automobile manufacturers.

An early finding in this study was that being ejected from the car considerably increases the possibility of injury or death. It was estimated that a reduction of 5,000 fatalities in the United States could be achieved each year by such means as improved door latches and the use of safety belts. Based on analyses of injuries sustained by 3,450 persons in 2,000 accidents, certain structures have been incriminated as important sources of injury to vehicle occupants. In addition to door latches that open and permit ejection, they are in descending order: the steering wheel and column, the instrument panel, windshield, top edge of front-seat back, door structures, and the lower part of the back of the front seat.

Another analysis in the Cornell study indicated that speed, when lower than 50 mph, is only partially correlated with the severity of injury. At the lower speeds especially, the design features in the car and the factor of ejection are of greater importance than the rate of travel at the time of the accident.

Transportation of Diseases

Another aspect of host-agent relationships is the spread of disease by various forms of transportation. Public health authorities recognize that certain diseases can be spread just as rapidly as the fastest means of transportation. However, many of the immigration, quarantine, and health regulations were adopted in reference to surface travel, and need

to be revised to keep pace with the modern airplane and the rapid transportation of persons from one part of the world to another (1).

The important implication of the speed of transit is that passengers can be conveyed from an infected to a noninfected area in less time than the incubation period of a disease, particularly by air transportation. Thus, infected travelers may directly expose other passengers and other persons prior to showing overt symptoms of disease, or bring a disease into an area which is free of the disease but contains a suitable vector. Also, there may be delay in proper treatment and appropriate preventive measures when the illness does become manifest because physicians in an area where it is not endemic may be unfamiliar with it (13).

There is also the possibility that insect vectors of disease may be carried to a noninfested area by aircraft. These insects may be merely transported and may spread disease by biting passengers during the flight. Or, escaping from aircraft after landing, they may become implanted in an area and produce new generations, creating a reservoir of infection. The possibility of transporting plant and animal diseases presents another important problem, held by some to be more serious than the threat to humans (31).

It had been predicted that diseases would be spread more easily with the advent of air transportation on a global basis. Thus far, however, there have been no major epidemics attributable to aviation. Contrary to the general impression, the epidemic of malaria in Natal, Brazil, in 1930 which later resulted in 100,000 cases was not introduced by aircraft. An evaluation of the time factors and the location of the original breeding sites at Natal in relation to the harbor and the airport led Soper to conclude that *Anopheles gambiae* was introduced, not by aircraft, but by the French destroyer making the mail run from Africa to Natal. Transportation by boat was also involved in the local epidemic of smallpox in the vicinity of Seattle in 1946 when a soldier returning from Japan came down with the disease while enroute and was hospitalized in that area (13).

Authenticated instances of the spread of disease through air transportation follow.

Toward the end of World War II, several

cases of smallpox were traced directly to a wounded soldier who arrived in San Francisco on a medical evacuation plane from Korea. He had apparently contracted the disease before enplaning and symptoms were not apparent on his arrival. Subsequently, approximately 100 cases developed in other parts of the west coast.

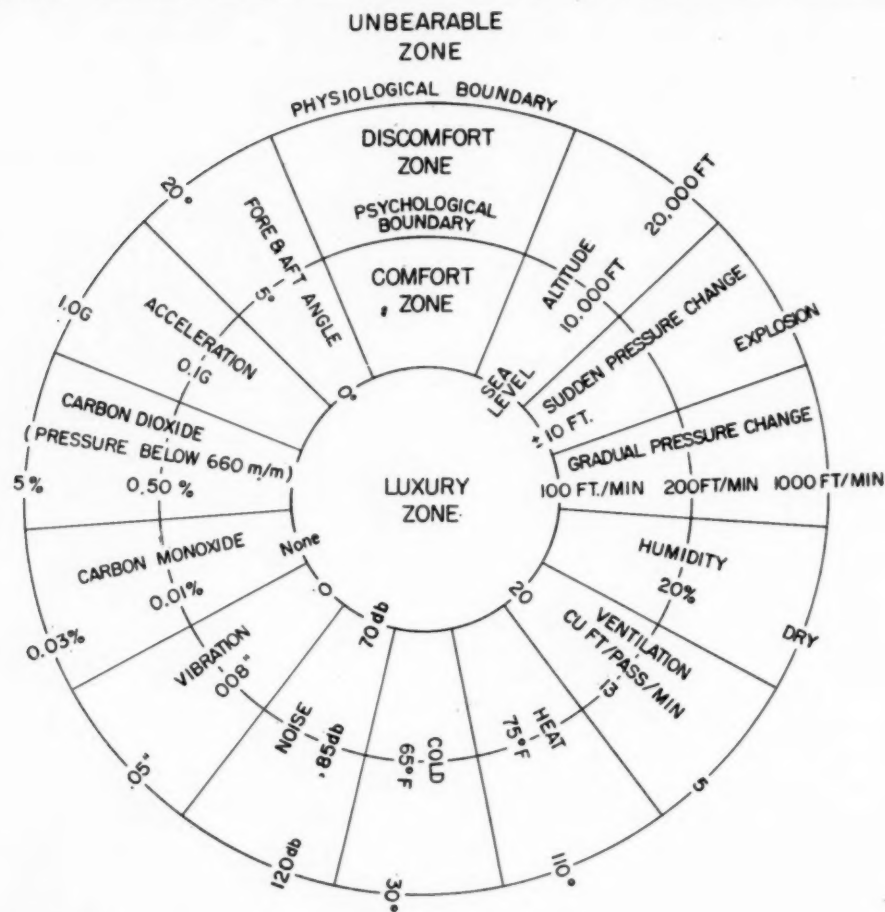
The so-called Arras epidemic of smallpox in 1946 in France was also traced to a soldier traveling by air. He had been stationed in Morocco and became ill during a flight to Italy, but he continued his journey to his home in Arras. He was not seen by a physician until 4 days had passed and was sent to a hospital with a diagnosis of chickenpox. Three days later the case was recognized to be smallpox, and in spite of revaccination of all known contacts a small epidemic followed, resulting in at least 1 death.

Another illustration concerns an outbreak of dengue fever in the Waikiki district of Honolulu in 1943. Several transport fliers arriving from the South Pacific had occupied an apartment in a Waikiki roominghouse. They had come through Suva in the Fiji Islands during an epidemic of dengue fever. Subsequently, the maids at this roominghouse became ill, and within a few weeks the Waikiki district became such a focus of infection that it was closed to military personnel until steps had been taken to virtually eliminate *Aedes* from the area.

An illustration of a potential epidemic is afforded by the case of a flight engineer who arrived in the eastern part of the United States 8 or 9 days after leaving a malarial area in Asia. He became ill shortly after arrival and was attended by a private physician who failed to recognize the disease, perhaps because of unfamiliarity with malaria. Two days later the airline's medical officer learned of the illness and had the patient hospitalized. Positive malarial smears were obtained, and despite intensive medical efforts the patient died from an overwhelming parasitemia of falciparum malaria approximately 13 or 14 days after infection. One may wonder how many more cases of malaria might have resulted if the appropriate mosquito vector, which is widespread in this country, had fed upon the patient (13).

The success of immunization procedures,

Figure 6. Comfort and tolerance limits for physical variables of the environment.



SOURCE: Reference 13.

modern methods for the disinsectization of aircraft, and other public health measures are responsible for holding the spread of disease to a very low incidence in air transportation. With these precautions it is possible that the threat of quarantinable and insectborne disease through air and surface transportation is of less importance to public health than such diseases as influenza and other virus infections. The proximity of passengers in closely confined quarters of an airplane cabin, bus, or railway car, especially when the air is recirculated, would facilitate the spread of airborne infections.

Host-Environment Relationships in Accidents

Many factors in the environment may influence the efficiency and safety of the operators of vehicles. Illumination, bad weather, and

toxic agents such as carbon monoxide are important in highway safety, while temperature, humidity, and ventilation are significant under extreme conditions. Noise and vibration are known to be excessive in certain types of highway vehicles. In aviation, the development of the pressurized cabin is of special interest since it affords an unusual illustration of the relationships between the host, the agent, and environmental factors affecting both health and safety.

Limits have been worked out for many of the environmental variables to show their influence on those who fly in air transports in terms of zones of comfort, discomfort, physiological harm, or intolerability. These are given schematically in figure 6. If the values in the innermost of the three concentric circles are adhered to, perfect comfort is assured. The second circle represents maximum limits for

comfort; hence if these values are exceeded discomfort will result. The outer circle presents values which would be physiologically harmful to the individual if they were reached or exceeded. While the chart has the advantage of brevity and clarity, it may be misleading if the values are accepted too rigidly, for many of them are interdependent. A comfort limit for noise, for example, is apt to be meaningless unless it is related to both frequency and duration. Similarly, the annoying features of vibration are functions of both the displacement amplitude and the frequency. The limits shown for carbon monoxide will be too high if persons are engaged in physical activity or are exposed to the gas while at high altitude (13, 31).

Efficiency of Vision

A significant factor in host-environment relationships is efficiency of vision. In the United States, accident rates per unit of travel are three times higher at night than during the day (7). Presumably, this is due partly to the lower visibility provided by night-time illumination, a contention supported by lower accident rates on lighted highways and by the reduction in rates following improvement of illumination on particular highways.

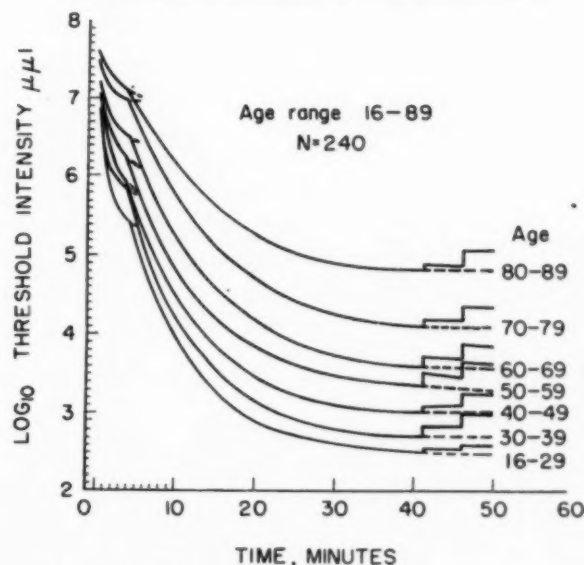
Older drivers are especially vulnerable in this connection, since the ability to see at low levels of illumination decreases regularly with increasing age. This effect is quite noticeable by middle age and becomes very marked in the elderly. We have calculated that for a dim light or object to be just seen by an eye in the dark, the illumination must be doubled for every increase of 13 years in age (32).

The use of tinted windshields by older drivers may present special hazards at night, since the glass further reduces visibility by reducing the intensity of light reaching the eye (10, 32). Figure 7 shows the increase in light for threshold perception as age increases. Slightly more intensity was needed at all ages when test lights were seen through ordinary clear windshield glass, which here is introduced at 41 minutes. When tinted glass is used, a larger increase in intensity is required. This illustrates in quantitative terms the importance of the interrelationship between factors relating to the host, the agent, and the environment.

Toxic Agents in the Environment

Exposure to subclinical concentrations of carbon monoxide frequently leads to effects which may not be noticed by drivers. Even very small amounts of this gas breathed into the lungs are taken into the blood stream, resulting in some degree of oxygen deficiency in the tissues. Early symptoms are lowered alertness, difficulty in concentration, slight muscular incoordination, and a mental and physical lethargy. Reduction of night vision can be demonstrated as one of the first effects (13). These initial symptoms are not permanently injurious, but owing to their nature, they may easily cause hazardous situations. Although, in general, exhaust systems have been improved to prevent the leakage of fumes, appreciable

Figure 7. A comparison of the average dark adaptation curves for eight age groups, each curve indicating the greater sensitivity of the retina as it becomes adapted to darkness.



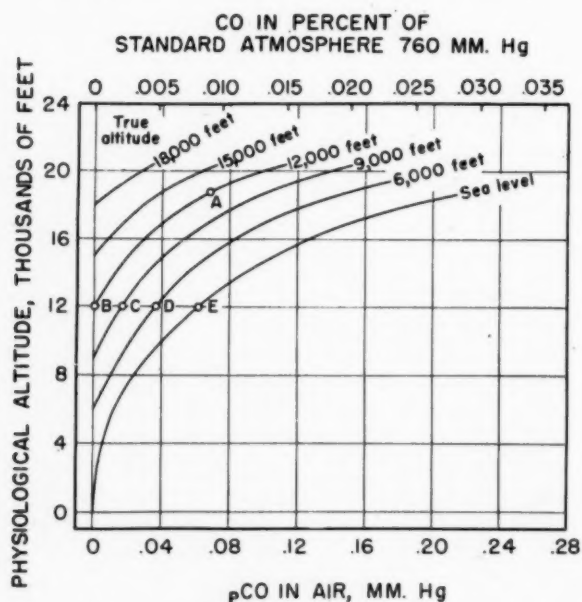
SOURCE: References 10 and 32.

NOTE: The first 4 or 5 minutes are concerned with cone vision; the remainder of the curve shows the adaptation of the rods. The vertical separation of the curves indicates the increase in intensity of light required for threshold perception (scale at left) as a function of increasing age. Also shown are the slight increase in intensity required when lights are viewed through clear windshield glass (at 41 minutes) and the relatively large increase in illumination needed when tinted windshield glass is placed before the dark-adapted eye (46 minutes). The latter effect may be somewhat more pronounced in the older groups.

concentrations of this gas have been found in the passenger compartment when the car stands with motor idling or moves slowly in dense traffic. Drivers should be well indoctrinated on the need for flushing vehicles with fresh air in such circumstances.

In addition, drivers and airmen should know that certain conditions will intensify the effect of carbon monoxide from engine exhaust (13). For example, the effect of carbon monoxide is obviously more pronounced the higher the altitude. If the blood of a chronic smoker at sea level already contains 5 to 7 percent carbon monoxide absorbed from tobacco smoke, he is affected as if he were a nonsmoker at an altitude of 7,000 or 8,000 feet. Figure 8 shows the combined effect of carbon monoxide and altitude as expressed in terms of the altitude producing an equivalent degree of anoxia. Thus, a person at sea level exposed to air with a partial pressure of 0.06 carbon monoxide would be affected to the same extent as if he were breathing uncontaminated air at 12,000 feet (31). If other oxygenation-reducing factors are present, such as the use of alcohol or certain medicines (sulfanilamide, barbiturate; or acetanilid, for example), the various factors may

Figure 8. The combined effect of carbon monoxide and altitude expressed as altitude producing an equivalent degree of anoxia.



SOURCE: Reference 31.

combine in their effects, resulting in a significant state of oxygen deficiency seriously jeopardizing safety (8).

Air Transportation of Patients

Patients are using air travel more and more because they can be transported to treatment and surgical centers rapidly.

The Flying Doctors Service of Australia, inaugurated in 1928, clearly demonstrated that the airplane provides an unusually effective way of transporting patients. During World War II the advantage of air travel for the sick and injured was dramatically demonstrated. Only 46 deaths occurred in flight in approximately 1,260,000 patient flights by the U. S. Air Force from all military theaters in the period January 1943 to April 1947.

A study has been made of the passenger deaths in the scheduled airlines of this country from 1930 to 1956. An extremely low rate, less than 1 death per million revenue passengers, has been found consistently. In 1955, for example, there were 22 in-flight deaths in 38 million revenue passengers, or a rate of 0.6 per million (13). Instances of loss of consciousness in flight (table 3) have also been found to be infrequent in comparison with the volume of traffic (33).

The chief precautionary measures for patients undertaking travel by air relate to (a) possible interference with the availability of oxygen and (b) the mechanical effects of the expansion of internal gases. If a physician understands the basic physiological principles involved, appropriate decisions can be made in regard to the advisability of air travel by individual patients (13).

Certain conditions may be characterized by a lowered oxygen saturation of the blood, or a limitation on the transport or utilization of oxygen when the body is placed under stress. Flight may thus be contraindicated or undertaken with caution by patients with certain forms of cardiovascular disease, pulmonary disease, anemia, diabetes, and overwhelming infections or shock, because of additional hypoxia due to altitude.

Among patients with cardiovascular diseases, flight may most frequently be contraindicated for those having limited cardiac reserve, or re-

Table 3. Instances of unconsciousness during flight in United States scheduled airlines, 1947-55, by associated condition and altitude

Associated condition	Persons losing consciousness	Altitude (unpressurized flight)		Cabin pressurized	Altitude or pressurization unknown
		0-8,000 feet	Above 8,000 feet		
Cardiovascular disease.....	80	19	25	22	14
Epilepsy, seizures, and convulsions.....	75	16	14	29	16
Fatigue.....	42	8	10	16	8
Motion sickness.....	41	23	2	9	7
Apparent hypoxia.....	17	2	9	16	0
Other and unknown.....	492	112	114	170	96
Total.....	747	180	174	252	141

¹ Includes 4 instances following accidental decompression.

SOURCE: Reference 33.

cent myocardial infarction. Such patients are already under stress to compensate for an insufficient supply of oxygen in heart muscle or are receiving only a marginal supply of oxygenated blood through the general circulation. Experience has shown, however, that altitude is probably not a critical factor for the cardiac patient unless either the disease or the exposure is severe. While those with a history of severe valvular disease, recent coronary thrombosis, or easily provoked angina probably should not fly, individuals with well-compensated heart diseases need not hesitate to fly at moderate altitudes, particularly if cabins are pressurized to about 6,000 feet, or if oxygen is available at all altitudes.

In some pulmonary conditions such as pneumonia, emphysema, and severe asthma, there may be preexisting oxygen want due to mechanical interference with the diffusion of oxygen into the blood in the lungs. In bronchial asthma there may also be oxygen want due to spasm of the smooth muscles of the finer bronchioles. With respiratory embarrassment as well, the individual severely ill with this condition will be unable to cope with the additional hypoxia of even moderate altitudes. The average asthmatic without emphysema, however, is not likely to be affected adversely by altitude.

Serious consequences may result if an anemic person flies at high altitude, and a patient with anemia of even moderate degree might be expected to react poorly to hypoxia because of the

impairment in the oxygen transport system of the blood. Transfusion before flight would be required by many with anemia or leukemia, and oxygen should be supplied from the ground up to patients with those conditions.

Air travel is not contraindicated for diabetics who are fully stabilized and can follow their time schedules for insulin and meals conscientiously. Difficulties may arise from either insulin reaction or diabetic coma. The effects of oxygen want are greatly accentuated when accompanied by low blood sugar, and the reaction may be more severe if fluid and food are lost by the patient because of air sickness.

Certain upper respiratory and thoracic abnormalities and abdominal and neurological conditions may be adversely influenced by the mechanical effects of the expansion of internal gases incident to the decreased barometric pressure at high altitude.

Sinus or otic barotrauma may result in persons with upper respiratory or middle ear disorders since such patients may experience difficulty in equalizing internal and external pressures, particularly during descents. If it is necessary to fly during an acute inflammatory phase, the use of vasoconstrictor drugs is indicated to secure adequate ventilation of the sinuses and middle ear to prevent damage and spread of infection.

One of the most serious contraindications to flight is the presence of pneumothorax. Several deaths in air travel have been traced to the

expansion of a large amount of encapsulated air in pneumothorax patients. If there is free air in the thoracic cavity, the expansion of this air may not only collapse the lung but may also displace the mediastinum, affecting other organs. Tidal air volume is also reduced. The various factors that affect the maximum safe altitude must be calculated for each person on each occasion when he travels. If flight is necessary, it is unwise to start immediately after a refill, and it may be advisable to aspirate the air from the pleural cavity to compensate for the decreased atmospheric pressure during flight.

The expansion of gases trapped in viscera and the abdominal cavity is the basis for contraindicating air travel for about 10 days after persons have undergone extensive abdominal surgery. Intestinal obstruction from any cause presents a serious problem, and if a patient must be transported, procedures to reduce accumulated gases should be followed. Perforated ulcer of the stomach and perforation of the bowel are other conditions that would contraindicate flight at any but low altitudes.

While the hazards of air travel in regard to neurological ailments have been least well defined, difficulties might be expected in patients (a) with air injected for diagnostic purposes, (b) with cranial injuries such that there may be herniation of the brain through openings in the skull, and (c) with conditions in which there may be an increase in intracranial or intraspinal pressures. Marked decreases in atmospheric pressure might be expected to affect such patients adversely. Experience suggests that routine flying as a passenger is not contraindicated for the epileptic whose seizures are controlled by drugs, and there is little indication that blood changes encountered in flight up to 10,000 to 12,000 feet are sufficient to induce seizures.

Effects of Loss of Pressure in Flight

After a sudden decompression at high altitude, passengers would be exposed to severe cold, and a few might develop "bends" if the plane were unable to descend to low altitude within a short time. The low tension of oxygen in the air at high altitude, however, is a limiting factor with the far more serious im-

plications of acute oxygen want. At 40,000 feet, for example, useful consciousness is retained for only 30 to 40 seconds. Even at 25,000 feet most persons would lose consciousness if exposed for 1½ to 2½ minutes unless supplementary oxygen were available (13).

Rapid decompressions have occurred in civil air transportation of the United States at a rate of about 1 incident in 100,000 hours of flying. Fortunately, most of these incidents so far have occurred below 25,000 feet, and planes have been able to descend to low altitudes immediately in almost all instances. In several it was necessary to provide oxygen to passengers showing signs of distress, and at least four instances of loss of consciousness have been reported. It is obvious that a decompression at 40,000 feet would present a very serious problem, and additional precautions will be necessary in the new jet transport equipment designed to operate at 35,000 to 40,000 feet. Unless cabin structures and pressurization are made completely foolproof and as reliable as any major component of the aircraft, it will be necessary to carry emergency oxygen equipment for all on board (34).

Conclusions

Accidents now rank above disease as the chief cause of death and disability to many segments of our population, and now constitute a major threat to the well-being and health of our people.

The accepted function of medicine has been the treatment of disease and injury. Just as the province of medicine has been extended to include the prevention of disease, it is proposed that the prevention of accidental trauma should be a responsibility of preventive medicine and public health.

When accidental trauma is considered a non-contagious mass disease of epidemic proportions, the epidemiological approach should be applied to the study and control of injuries since similar biological principles are involved. An interdisciplinary approach is a basic requirement in this because multiple causation is found in most accidents.

The causes of accidents may be identified in the interactions between the host, the agent (or

equipment), and variables of the environment. Human factors are especially important, and the physician can contribute effectively in the analysis of accident causes because of his background in the biological sciences and his knowledge of human behavior. He can indoctrinate his patients and teach while treating.

Factors of significance to the host in the control of accidental trauma include not only those which determine suitability for a given task such as driving a vehicle or piloting a plane, but also such factors as age, training, and, particularly, personal adjustments. The most promising approach to identifying the accident repeater is based on the concept that "a man works, or drives, as he lives."

The control of various temporary host factors such as fatigue, emotional problems, effects of alcohol, and the influence of disease is highly important. Periodic medical examinations and adequate programs of health maintenance can play a significant role in improving safety both in land and air transportation.

Biotechnology and human engineering should be applied to the design of equipment in order to achieve a closer integration between the operator and his equipment.

The agent of disease also is significant in modern transportation, since insect vectors of disease might be transported in planes and other vehicles and since long journeys may now be completed within the incubation period of most contagious diseases. A review of epidemics attributable to transportation indicates that thus far the spread of disease through air transportation has been less than predicted but that the constant threat to public health must be continually controlled.

Host-environment relationships also have implications for safety in transportation because of the influence upon the individual of physical variables such as the level of illumination, the temperature and humidity, and exposure to carbon monoxide and other toxic agents. Data have been worked out for each of these variables outlining the zones of comfort and discomfort and the ranges where human performance is adversely influenced.

In air transportation, the low tension of oxygen at high altitudes and decrease in barometric pressure with altitude are significant not only

for their influence on the performance of airmen, but also because of their implications for the safety of travel by air by persons who are physically unfit or who are afflicted with certain diseases or physical conditions. These same factors are of critical importance in the development of equipment to transport passengers at very high altitudes because of their significance in the case of a sudden loss of pressurization.

In conclusion, the physician or the public health officer has a direct responsibility for the prevention of accidental trauma. He may contribute most effectively by his aid in carrying out controlled experimental and clinical studies, epidemiological surveys, and by collaborating with specialists in other biological sciences, engineers, and administrative officers in a combined approach to this problem.

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1957 Summary of Disease Outbreaks

CARL C. DAUER, M.D.

THE NUMBER of disease outbreaks reported in 1957 for which either water or food was the vehicle of infection was essentially the same as in the past few years (table 1). The number of outbreaks reported by the various States apparently bore no direct relationship to the size of their populations but reflected the extent of activities in investigating epidemic occurrences. The number for a few States was relatively large because of the inclusion of outbreaks occurring on military installations located within their borders.

The method used to tabulate outbreaks was changed slightly from that used in previous summaries. Only those outbreaks with laboratory confirmation of a specific type of food poisoning or food infection were placed in definite categories such as salmonellosis, shigellosis, or staphylococcal food poisoning (table 2). Those without such confirmation were classed as gastroenteritis, etiology unknown. This change accounts largely for the sizable reduction of outbreaks attributed to staphylococcal food poisoning, approximately 50 percent compared with the years 1955 and 1956, when many outbreaks were classified according to clinical and epidemiological findings.

In addition to the usual method of tabulating the number of various types of outbreaks by States, each of the principal types of foodborne outbreaks was tabulated by kind of food involved and by either the place of occurrence or the source of food. As shown in table 3, poultry and other meats were associated with a large proportion of these occurrences. It is also apparent that a large proportion occurred in

groups of persons eating in public establishments and in private homes. However, the average number of persons per outbreak was relatively small as compared with the number in outbreaks occurring in schools or institutions and at social gatherings such as picnics and church gatherings.

No improvements in food-handling practices are apparent. Lack of refrigeration, exposure at room temperatures, or handling of food by persons with infections were mentioned frequently as contributing to or as the direct cause of the outbreak.

Waterborne Outbreaks

Comparatively few outbreaks occurred in 1957 for which water was demonstrated to be the vehicle of infection. In one instance, two persons with typhoid fever had used water from a dug well which presumably was contaminated by a chronic carrier who lived nearby. Gastroenteritis of unknown etiology occurred in two groups of individuals using water from wells that showed evidence of fecal contamination. One small group of cases of gastroenteritis occurred among passengers on an airplane. Inspection of the plane's drinking water supply suggested that it was the probable source of the illness.

Milkborne Outbreaks

Market milk was not reported as the source of infection in any outbreak of disease in 1957. However, two cases of brucellosis were found in one family in which raw milk had been used for a period of about 2 years. A case of Q fever was found in an individual who consumed raw

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milk during a milk strike. Some of the cows in the dairy supplying the milk were shown by laboratory tests to be infected with Q fever.

Milk products, mainly ice cream, were vehicles of infection in six outbreaks. Three of the five involving ice cream were caused by *Salmonella*. Since raw eggs were used in preparing the ice cream in two of these outbreaks, it is possible that they were the primary source of infection. In one instance, cream cheese served in a restaurant was thought to be the probable source of infection for a small group of persons with gastroenteritis.

Typhoid Fever

Only four outbreaks of typhoid fever were reported in which either food or water was definitely incriminated. Two cases occurred among workmen of a small factory supplied with drinking water from a dug well. The well probably was contaminated from a nearby cesspool receiving the stools of a known carrier. An explosive outbreak totaling 38 confirmed and 27 suspect cases of typhoid fever occurred in an institution. The outbreak was considered to be foodborne since the water supply was found satisfactory in every respect. One of the persons living in the institution was found to be a carrier. It was determined that she carried the same phage type (E_1) organism that was found in a number of the cases. In another outbreak of 17 cases, 14 were confirmed by isolation of a phage type (E_1) organism. All of the patients were members of the 7th grade of a public school. The manager of the cafeteria in the school was found to be a carrier and is presumed to be the source of infection, but the mode of contamination or the specific food involved was not determined. In another instance of 13 cases all of the patients had eaten in a restaurant where a carrier, not previously known, was employed as a busboy.

A group of three cases, not included in the tables, occurred in preschool children living in the same apartment building. A known carrier lived in this building, and another lived in another part of the housing development, but neither had any known contact with the

children. The organisms recovered from the first carrier and the children were all shown

Table 1. Foodborne and waterborne disease outbreaks reported in 1957, by vehicle of infection

Area	Water		Milk and milk products ¹		Other foods ¹	
	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases
United States	4	131	8	67	250	11, 085
New England:						
Maine					5	49
Massachusetts					7	383
Rhode Island					3	66
Connecticut	1	25			3	38
Middle Atlantic:						
New York	1	2	1	5	18	936
New Jersey			1	1	5	424
Pennsylvania					1	17
East North Central:						
Ohio					2	42
Indiana					2	338
Illinois	1	100	1	16	14	317
Michigan					2	104
Wisconsin					3	115
West North Central:						
Minnesota					4	109
Iowa					2	20
Missouri					3	279
North Dakota					1	32
Nebraska					5	1, 394
South Atlantic:						
Maryland					12	1, 034
Virginia					6	237
West Virginia					1	100
North Carolina			1	6	3	177
South Carolina					2	75
Georgia					3	135
Florida					2	55
East South Central:						
Kentucky			1	2	5	60
Tennessee			1	19	4	233
Alabama					2	222
West South Central:						
Arkansas			1	16	2	36
Louisiana					5	1, 232
Mountain:						
Wyoming					1	4
Colorado	1	4			1	1
New Mexico					2	12
Arizona					2	165
Pacific:						
Washington					5	88
Oregon					4	137
California			1	2	106	2, 404
Hawaii					1	6
Not known					1	9
United States 1956	9	1, 719	31	873	210	11, 133
United States 1955	2	22	3	302	193	9, 633

¹ Includes outbreaks among military personnel.

Table 2. Foodborne, waterborne, and other disease outbreaks reported in 1957, by type of infection

Area	Ty-phoid fever		Salmonel- losis ¹		Shigellosis		Trichi- nosis		Botu- lism		Staphylo- coccal food poisoning ¹		Strepto- coccal infections		Gastro- enteritis, etiology unknown ¹		Toxic agents	
	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases	Outbreaks	Cases
United States.....	4	70	30	1,607	11	754	1	14	6	12	58	1,660	4	1,030	135	6,065	8	68
New England:																		
Maine.....			2	8							2	26			1	15		
Massachusetts.....											2	110			5	273		
Rhode Island.....											2	34			1	32		
Connecticut.....											3	38			1	25		
Middle Atlantic:																		
New York.....	1	2	2	132	1	200	1	4			6	124			7	478	2	3
New Jersey.....			1	176					1	1					3	247		
Pennsylvania.....	1	17																
East North Central:																		
Ohio.....			1	12													1	30
Indiana.....	1	38											1	300				
Illinois.....			1	7							4	67			11	359		
Michigan.....											1	85			1	19		
Wisconsin.....															3	115		
West North Central:																		
Minnesota.....			1	45	1	11					1	10			1	43		
Iowa.....											1	3			1	17		
Missouri.....											3	279						
North Dakota.....															1	32		
Nebraska.....															5	1,394		
South Atlantic:																		
Maryland.....			1	20					1	2	2	52	1	600	7	360		
Virginia.....					2	90									3	131	1	16
West Virginia.....													1	100				
North Carolina.....			2	20							1	150			1	13		
South Carolina.....			1	39											1	36		
Georgia.....											1	66			2	69		
Florida.....					1	50									1	5		
East South Central:																		
Kentucky.....											2	13			4	49		
Tennessee.....			1	19							1	69			3	164		
Alabama.....					1	192									1	30		
West South Central:																		
Arkansas.....			1	16											2	36		
Louisiana.....			1	423											3	806	1	3
Mountain:																		
Wyoming.....							1	4										
Colorado.....									1	1					1	4		
New Mexico.....			1	11					1	1								
Arizona.....											2	165						
Pacific:																		
Washington.....					1	41			1	5	1	3			2	39		
Oregon.....											1	3			3	134		
California.....	1	13	14	679	4	170			1	2	21	354	1	30	60	1,140	3	16
Hawaii.....							1	6										
Unknown.....											1	9						
United States 1956.....	7	52	23	1,999	8	1,107	11	98	11	22	111	4,313			88	6,688	9	160
United States 1955.....	5	36	16	971	10	475	5	92	5	14	102	4,130			66	5,160	5	99

¹ Includes outbreaks among military personnel.

to be phage type E₁. Overflow of sewage from the building into the basement was pumped out on a lawn used by the children as a play area. It is possible that the children were infected on the playground. In another area, floods occurring in late spring washed out sewer mains and covered the sewage treatment plant of a large city. Seven cases are believed to have resulted directly or indirectly from this interruption of sewage disposal. One case in the same city was considered to have resulted from a fall into the river when it was highly polluted with sewage.

Salmonellosis

Thirty outbreaks of salmonellosis were reported in 1957, all of which were confirmed by

recovery of organisms either from the stools of those who were ill, from food handlers, or from specimens of food. In six of the outbreaks, poultry meat—usually turkey—was eaten. A comparatively large number of the outbreaks occurred in homes. The smallest consisted of 3 cases and the largest of 70 cases following a wedding reception at which turkey was served. One large outbreak occurred simultaneously among persons attending dinners in several churches of one community. The food served by a single caterer from another State was transported about 400 miles in this outbreak.

Fifteen types of *Salmonella* organisms were isolated in the 30 outbreaks. Among the types recovered were *S. typhimurium* in 11, *S. newport* in 4, *S. montevideo* and *S. tennessee* in 2

Table 3. Outbreaks of certain foodborne diseases reported in 1957, by type and source of food

Source	Salmonellosis		Shigellosis		Staphylococcal food poisoning		Streptococcal infections		Gastroenteritis, etiology unknown	
	Number of outbreaks	Number of persons affected	Number of outbreaks	Number of persons affected	Number of outbreaks	Number of persons affected	Number of outbreaks	Number of persons affected	Number of outbreaks	Number of persons affected
Type of food										
Poultry.....	6	464	1	50	10	340	1	30	18	1, 188
Other meat.....	2	21	1	3	21	519	0	-----	41	1, 496
Custard-filled dessert.....	2	23	0	-----	10	167	0	-----	12	186
Salad.....	3	105	1	192	2	36	2	900	7	456
Other.....	7	135	1	12	10	231	1	100	12	106
Not determined.....	10	859	7	497	5	367	0	-----	42	2, 503
Total.....	30	1, 607	11	754	58	1, 660	4	1, 030	132	5, 935
Source of food										
Public eating establishments.....	5	274	3	73	10	111	0	-----	39	421
Private clubs.....	5	498	0	-----	4	147	1	100	5	179
Schools.....	0	-----	2	289	5	158	0	-----	8	897
Colleges.....	0	-----	1	79	1	7	0	-----	3	617
Hospitals and institutions.....	3	38	2	91	2	41	0	-----	3	700
Recreation camps.....	0	-----	0	-----	2	96	0	-----	4	184
Labor camps.....	0	-----	0	-----	3	161	0	-----	7	213
Social gatherings.....	2	508	0	-----	7	337	3	930	11	1, 230
Bakery caterers.....	1	3	0	-----	11	111	0	-----	5	97
Private homes.....	12	233	2	22	9	63	0	-----	23	181
Transportation.....	1	14	0	-----	0	-----	0	-----	3	89
Other.....	1	39	1	200	4	428	0	-----	21	1, 127
Total.....	30	1, 607	11	754	58	1, 660	4	1, 030	132	5, 935

each. In one outbreak 2 types, *S. give* and *S. sandiego*, were recovered; in another, 3 types, *S. barielly*, *S. montevideo*, and *S. reading*.

Early in 1957 it was noticed that an unusual number of *S. reading* infections were occurring. A sharp rise in the number began in September 1956 and reached a peak of 71 cases in February 1957. Infections were identified almost simultaneously in several widely separated areas of the country. During the 12-month period beginning in September 1956, there were 325 acute, sporadic cases and 3 outbreaks due to this type of organism. Previously *S. reading* was very rarely identified among the *Salmonella* isolates from human or animal infections occurring in the United States. Of the cases reported, 70 percent were in children 6 years of age or under and 18 percent in children under 1 year. The epidemiological picture strongly suggested a widely distributed common source of infection, but despite intensive investigation by means of detailed food histories, no common vehicle was identified.

Shigellosis

Eleven outbreaks of shigellosis were reported in 1957. Water was not regarded as the vehicle in any of them. As shown in table 3, three of them involved eating in public eating places, two occurred in institutions, and two in schools. The food involved in transmission of the infection was not determined in 7 of the 11 outbreaks. *Shigella sonnei* was recovered in 2 outbreaks, *Shigella flexneri* in 4, and the species was not stated in the remaining 5.

Trichinosis

Three relatively small outbreaks of trichinosis were reported in 1957. In one family outbreak comprising 4 cases, sausage or chopped beef that may have been contaminated in a meat grinder was the probable source of infection. Four other cases, proved by biopsy, followed consumption of homemade garlic sausage. Consumption of raw pork and liver preceded acute trichinosis in 6 patients, 3 of whom died. Numerous trichina larvae were found at autopsy of two and by muscle biopsy

in others. Calcified cysts indicating previous infestations were found in some of the specimens. Specimens from a slaughtered pig also showed numerous trichina larvae.

Botulism

Six separate reports of botulism afflicting 12 persons were reported in 1957. Home-canned foods had been eaten in each instance. These included a gluten preparation, sausage, mushrooms, stringbeans, corn, and tuna fish. The type of infection was reported in only one instance, type A botulinus toxin being found in the tuna fish. Four of the 12 persons with botulism died.

Staphylococcal Food Poisoning

Most of the 58 outbreaks of staphylococcal food poisoning reported occurred in groups of persons who had eaten in public establishments or in private homes, or had consumed food obtained from bakeries and caterers. Poultry and other meats were most commonly associated with these outbreaks. Eclairs and custard-filled cakes and pies were proved by laboratory tests to be the vehicles of infection in only 10 outbreaks. These types of food were suspected in 12 additional episodes, but the cases were tabulated as gastroenteritis, etiology unknown, because laboratory confirmation was not obtained.

Streptococcal Infections

Four relatively large epidemics of streptococcal infection were traced to food eaten at social gatherings. In one instance, it was estimated that about two-thirds of the 900 who attended a charity luncheon became ill with septic sore throat. Egg salad served at the luncheon was considered to be the vehicle of infection. In another epidemic which occurred among those attending a social, the potato salad was found to contain large numbers of streptococci. Symptoms of gastroenteritis characterized the illness. Thirty persons became ill with cramps and diarrhea following a church picnic where chicken salad was served. This food contained streptococci. Following a school picnic in another area, large numbers of strepto-

cocci were found in meat loaf, potato salad, and coleslaw served to the children, 100 of whom developed gastroenteritis.

Gastroenteritis, Etiology Unknown

The number of reported outbreaks with unknown etiology constituted more than half of the total of foodborne and waterborne outbreaks. In about 45 percent of them, poultry and other meats were considered the vehicles of infection. About the same percentage occurred in persons eating in public eating establishments and in private homes. In most of the 132 foodborne outbreaks, investigators were unable to obtain specimens of food for laboratory testing. In a small number, specimens were obtained but showed none of the organisms usually associated etiologically with food infection or food poisoning.

Chemical Poisoning and Noxious Foods

In one of the four reports of chemical poisoning, 3 persons showed clinical signs of acute lead poisoning. They had cramps and diar-

rhea and complained of a metallic taste after eating duck meat. The ducks had been shot and stored in a freezer for 2 months. A laboratory test showed the presence of lead in leftover portions of the duck meat. In another outbreak, lemonade prepared in a cadmium-lined can produced illness in every person who drank it at a school picnic. The lemonade contained 62.7 ppm of cadmium, and vomitus from patients contained 15.0 ppm of the metal. A case of poisoning occurred in one child who ate chocolate-covered ice cream on a stick. A washing powder, sodium metasilicate, may have spilled into the molds used in making the ice cream sticks, or it may have remained in the molds after cleaning. In another instance, 16 persons became ill shortly after eating breakfast on an excursion boat. The type and source of toxic agent could not be determined.

In four outbreaks reported, ingested foods produced toxic symptoms. In two instances, mushrooms were eaten. Castor beans caused illness in another. Consumption of smoked fish was reported as the probable cause of acute toxic symptoms in six persons.

Conference on Staphylococcal Infections

A conference on staphylococcal infections will be held at the Communicable Disease Center of the Public Health Service in Atlanta, Ga., September 15-17, 1958.

Representatives of 40 hospital, medical, and other professional organizations will confer on control measures that can be established in hospitals and communities to deal with the mounting problem of infections caused by bacteria which are resistant to penicillin and other antibiotic drugs.

The conference, recommended by the American Hospital Association, will be sponsored by the National Research Council and the Public Health Service.

In comparison with other members of HIP, those over 65 have a higher rate of physician visits. Greater use of services from both specialists and family physicians and more visits in the hospital account for the differences.

Experience With Older Members in a Prepaid Medical Care Plan

SAM SHAPIRO, B.S., and MARILYN EINHORN, A.B.

VOLUNTARY health insurance for older people (those 65 years and over) has expanded in recent years but still lags behind coverage for the population of the United States as a whole. It is estimated that in 1955 about 65 percent of the total population had some type of health insurance (1), while only about 41 percent of the noninstitutionalized aged were covered (2).

Reduced incomes, retirement, and enrollment restrictions are among the reasons why most of the aged do not have health insurance. Also contributing is the fact that when many of today's older people were in the labor force health insurance was not so widespread as it is now.

The need for finding ways to extend the benefits of voluntary health insurance to more of the aged is generally recognized as acute and is receiving attention by government, employer and union groups, and the prepayment plans (2).

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Necessary in considering solutions to this problem is information regarding requirements and expenditures for medical care of the aged. In the last few years, this type of information has expanded significantly through studies of general population groups (3). An item about which a great deal more knowledge is needed, however, is the experience of health plans that currently enroll the aged.

The Health Insurance Plan of Greater New York is such a plan. A prepaid voluntary plan now about 11 years old, HIP is organized on a group practice basis and provides comprehensive medical care. Persons covered are entitled to receive medical care from family physicians and specialists in the office, the home, and the hospital. The insurance pays for preventive and diagnostic medical services and for treatment of illness. Laboratory, radiological, and other diagnostic tests as well as physical therapy and services of visiting nurses are included. The only medical services excluded are treatment by a psychiatrist, purely cosmetic surgery, care for drug addiction, anesthesia, and care for chronic illnesses in institutions other than general hospitals.

There are no waiting periods for service in HIP, no exclusions from enrollment because of preexisting conditions, and no limitations on the number of services or duration of medical

Explanatory Notes

Statistics in this report are derived from an enrollment card prepared for each HIP subscriber and from a physician's report form on which the physician records information about each contact with an HIP member. The enrollment card gives the age, sex, and a history of all changes in coverage status for each person insured. The physician's report includes statistics on the age and sex of patients as well as information on where the service was given and the medical specialty.

Physician visits. In general, physician visits refer to face-to-face contacts between the physician and the patient in the office, home, or hospital. Each preoperative visit and each postoperative visit, as well as the operation itself, is considered one physician service. Similarly, each prenatal visit and each postpartum visit is counted as one service.

In counting services of radiologists each reading of an X-ray film of a body part and each field treated with deep roentgen therapy is considered one service. Also counted as one service is each visit for superficial therapy irrespective of the number and location of the fields treated.

Physician visit rates. The average number of physician visits per person per year is obtained by

relating the number of visits to HIP physicians during the year to the average number of persons enrolled in the plan. Average enrollment is the total number of person-months of coverage in a year divided by 12. This, in effect, takes account of the fact that some members are in the plan for only part of a year.

Sampling ratios. Tables showing enrollment and physician utilization experience are based on sample tabulations. The sampling ratio for a specific set of data is indicated in a footnote to the pertinent table. To reduce sampling variability, data are usually combined for a 2- or 3-year period.

Hospitalization rates. Hospitalization rates reflect experience of a 20 percent sample of HIP subscribers who are employees of the city of New York and their dependents enrolled in HIP throughout 1955. All of the enrollees have Blue Cross hospital insurance. Data regarding hospital admissions and length of stay in 1955 were obtained from the claim files of Blue Cross and refer to all hospitalizations in the group, regardless of the type of hospital (voluntary, proprietary, or municipal) or whether the physician was associated with HIP.

care. Medical services are provided by physicians associated with 32 medical groups. Each medical group receives an annual capitation payment for each insured person in that group. Members receive no bill for medical services, the premium paying the entire cost. (The only exception is a possible \$2.00 charge for a night call to the home between 10 p.m. and 7 a.m.)

Enrollment Composition

On June 30, 1957, there were 513,052 persons enrolled in the Health Insurance Plan. About 67 percent were employees of New York City and their dependents; 19 percent were insured through health and welfare plans established by labor groups; 7 percent had converted from group to individual contract; and the remaining 7 percent came from a variety of small employment groups and housing projects.

Initial enrollment is on a group basis only, the usual requirement being that at least 75 percent of those eligible enroll. Contracts ordinarily provide for coverage of the employee (referred to in this report as the subscriber), spouse, and dependent children under 18 years of age. However, a number of union health and welfare plans have signed contracts providing coverage only for the employee. On June 30, 1957, 7.2 percent of HIP's members (subscribers and dependents) were under this type of contract.

Two provisions in the enrollment regulations of HIP are particularly important to older people. First, there are no exclusions because of age or physical condition. Second, any subscriber leaving his group, because of change of job, retirement, or the like, may convert to an individual contract without any loss in benefits. This privilege to convert is not restricted in

any way, not by age, medical condition, nor previous use of services.

In 1957, 23 percent of HIP's members aged 65 years or over had individual contracts as compared with 5.4 percent for all other ages. The age and sex composition of the aged converttees more closely approximates that of the older people in the general population than does the composition of the aged under group contract. More than half of the aged who had converted are over 70 years old, whereas only a fourth of the other aged in HIP are that old (table 1). Also, women constitute a higher proportion of the converttees 65 and over than of the aged under group contract.

Despite the comparatively high percentage of older people with individual contracts through conversion, the proportion of HIP's total enrollment that is 65 years or over (3.6 percent) is substantially lower than the figure for New York City as a whole (9.1 percent). This differential is not surprising since the source of HIP's subscribers is basically employment groups. In time, it might be expected that the conversion privilege would result in a narrowing of the differential. However, there are important deterrents to this process, as discussed in the next section.

Maintenance of Coverage

Experience during the period 1952-54 indicates that each year about 20 percent of the

aged subscribers under group contract are listed for termination of enrollment (table 2). Mortality accounts for almost a fourth of this group. The remaining 16 percent may be listed for termination because the subscriber left his employment group or because he decided to drop HIP. Considering the age group, the principal factor would appear to be retirement from the labor force. (For a detailed analysis of termination rates, based on 1948-51 experience, see reference 4.)

Of the 16 percent listed each year for termination for reason other than death, close to two-thirds fail to convert from group to individual coverage. Since retirement from the labor force is in prospect for all the aged, this rate of loss means that most subscribers at advanced ages drop their insurance. The loss among subscribers under 65 listed for termination is also high (81 percent), but future medical insurance coverage for this group is a distinct possibility, through new jobs or through employed spouses, for example. On the other hand, coverage for the aged once their enrollment has terminated is very unlikely.

The high loss in coverage among subscribers 65 or over is undoubtedly due in part to the financial burden conversion represents. The premium rate under individual contract obtained on conversion is only slightly higher than the rate under group contract. For a two-person family, for example, a group contract costs \$85.45 a year, and an individual contract, \$90

Table 1. Age, sex, and enrollment status of HIP members, June 30, 1957

Age and sex	Number of members			Percentage distribution of members		
	Total	Individual contract by conversion	Group contract	Total	Individual contract by conversion	Group contract
All ages.....	501, 360	30, 240	471, 120	100. 0	100. 0	100. 0
Under 65.....	483, 330	26, 170	457, 160	96. 4	86. 5	97. 0
65-69.....	12, 150	1, 900	10, 250	2. 4	6. 3	2. 2
70 or over.....	5, 880	2, 170	3, 710	1. 2	7. 2	. 8
65 or over.....	18, 030	4, 070	13, 960	100. 0	100. 0	100. 0
Males.....	11, 410	2, 140	9, 270	63. 3	52. 6	66. 4
Females.....	6, 620	1, 930	4, 690	36. 7	47. 4	33. 6

NOTE: Data are based on a 10 percent sample. They refer to persons enrolled in HIP medical groups and exclude a small number of members residing outside

the areas covered by the medical groups. Including out-of-area members, the enrollment on June 30, 1957, was 513,052.

Table 2. Conversion to individual contract in HIP, annual averages, 1952-54

Enrollment action	Number of subscribers ¹			Percent of total		
	All ages ²	Under 65 ²	65 or over ³	All ages ²	Under 65 ²	65 or over ³
Listed for termination, all causes ⁴ -----	45, 500	42, 470	3, 030	11. 6	11. 3	20. 4
Listed for termination, excluding deaths ⁵ -----	41, 730	39, 400	2, 330	10. 7	10. 5	15. 7
Subscribers who convert-----	8, 300	7, 430	870	⁶ 19. 9	⁶ 18. 9	⁶ 37. 3

¹ Subscribers under group contract except those under contracts with special provisions for insuring the aged on retirement. Subscriber is the person (usually an employee) through whom the family obtained the insurance.

² Based on a 2 percent sample of changes in enrollment status.

³ Based on a 10 percent sample of changes in enrollment status.

⁴ The group for whom a change in status from group enrollment to either individual enrollment or discon-

tinuation in coverage is required. Occurs when subscriber leaves his group because of retirement or loss or change of job, death, or decision to drop HIP insurance.

⁵ Mortality estimated on basis of rates for white males and white females in Middle Atlantic States, Life Tables for the Geographic Divisions of the United States, 1949-51, Vital Statistics—Special Reports, vol. 41, No. 4, 1956.

⁶ Percent of subscribers listed for termination, excluding deaths.

(not including costs for hospital insurance). The difference, however, is not usually the total increase in out-of-pocket cost to the subscriber, since the great majority enter HIP through group contracts in which part or all of the premium (most often half) is paid by the employer or the union health and welfare fund. On conversion, the subscriber must pay the total premium himself. Thus, on retirement from the labor force the aged are usually faced with a substantial increase in cost of health insurance at a time when their income is reduced and, as will be shown, when their medical needs are great.

Finding ways to permit the aged to maintain their insurance is a major challenge to the community, employer and labor groups, and voluntary health agencies. Steps have already been taken by a number of health and welfare funds to retain the aged employee as part of the group after retirement and to continue paying the premium, but this arrangement is the exception rather than the rule. Only 10 percent of the subscribers in mid-1957 were enrolled by contractor groups that continue to pay the premium after the employee retires.

What about the subscribers who do convert? How long do they remain covered? At the end of the first year, 89 percent of the aged convertees are still in HIP. The rate of attrition diminishes in succeeding years, and by the end of the fourth year 76 percent remain excluding the loss due to death (table 3).

Among subscribers under 65 who convert, the pattern of retention of coverage in HIP is quite different from that for the aged. Only 73 percent are left after a year and 61 percent after 2 years. The loss becomes negligible after that, and 59 percent of these subscribers are in HIP for 4 or more years after conversion.

The far greater loss in the first year among subscribers under 65 than among the aged may well reflect a difference between the two groups in the type of services they anticipate. The aged may expect to need medical care of long duration, whereas the group under 65 will more

Table 3. Retention of coverage by HIP subscribers after conversion to individual contract, 1952-54

Minimum duration of coverage after conversion (years)	Percent of subscribers ¹ retaining coverage, excluding deaths ²		
	All ages ³	Under 65 ³	65 or over ⁴
1-----	74. 4	72. 5	88. 5
2-----	63. 5	60. 8	82. 0
3-----	62. 1	59. 7	76. 9
4-----	61. 7	58. 9	75. 5

¹ Subscriber is the person (usually an employee) through whom the family obtained the insurance.

² See footnote 5, table 2.

³ Based on a 2 percent sample of changes in enrollment status.

⁴ Based on a 10 percent sample of changes in enrollment status.

likely require short-term care, such as obstetrical or pediatric services. Furthermore, other opportunities for group enrollment may appear for the subscriber under 65, but not for the aged.

Volume of Services

The amount of medical care an HIP member receives is unrestricted by administrative regulation. Members are encouraged to use medical group service efficiently and to employ sound health practices based on current scientific knowledge through a varied and continuous educational program which HIP's division of health education has helped each medical group to develop.

In this setting, one might expect a pattern of medical care behavior different in some respects from that of the general community. The results of a household survey conducted in 1952 suggest that this is indeed true (5). This study indicates that the proportion of HIP members who see a physician sometime during the year is higher than the figure for the total popula-

tion of New York City, 69 percent as compared with 57 percent. The time between onset of illness and when a doctor is seen seems to be somewhat shorter for persons covered by the plan, but once having seen a physician for a particular ailment HIP members appear to make fewer visits than do persons in the city as a whole. These findings provide a broad, general background for interpreting the rates of medical care presented in the rest of this report.

Seventy percent of the members 65 years of age and over see an HIP physician at least once during the year (table 4). This is about the same proportion as in the age group 45-64 years, but it is somewhat below the figure for younger adults and appreciably lower than the figure for children. The finding that 3 in 10 of those of middle and advanced age do not see a doctor during the year is of particular interest because of the special emphasis on the value of periodic medical examinations at these ages. It is apparent that the availability of comprehensive medical care with no economic deterrent does

Table 4. Physician visits by age, sex, and conversion status of HIP members

Age and conversion status	Percent of members seen by HIP physicians, July 1, 1955-June 30, 1956 ¹			Number of physician visits per person per year, 1955-56		
	Total	Male	Female	Total	Male	Female
<i>All members</i>						
All ages	74.0	72.5	75.5	² 5.2	4.8	5.5
Under 65	74.2	72.8	75.7	5.1	4.7	5.5
Under 15	82.0	82.7	81.4	5.0	5.4	4.7
15-44	72.1	69.7	74.3	4.9	3.9	5.9
45-64	68.8	66.6	71.4	5.5	5.2	5.9
65 or more	69.7	68.6	72.0	7.3	7.6	6.8
<i>Individual contract by conversion</i>						
All ages	85.6	83.8	87.3	7.5	6.8	8.1
Under 65	85.8	83.9	87.5	7.3	6.3	8.2
65 or more	83.6	81.3	85.9	9.3	10.8	7.6
<i>Group contract</i>						
All ages	73.2	71.9	74.7	5.0	4.7	5.4
Under 65	73.5	72.3	74.9	5.0	4.7	5.4
65 or more	65.6	65.9	65.0	6.9	7.0	6.5

¹ Data apply to subscribers enrolled in HIP throughout this period and their dependents who were insured on June 30, 1956.

² This figure differs somewhat from the rate (5.3) based on 100 percent counts.

NOTE: Data based on a 10 percent sample of the HIP enrollment.

not, by itself, insure the use of preventive services.

Despite the comparatively low proportion of older members who see a physician, the average number of visits this group makes during the year (7.3) is 40 percent higher than the rate for HIP as a whole (5.2). The difference results from the fact that more of the older people than of other age groups receive large volumes of service. Among the aged 8.3 percent see a doctor at least 20 times in a year as compared with 4.2 percent of all members. Another point of interest is that aged members who receive this many services account for almost half the care (47 percent) obtained by the entire group 65 or older.

The rate at which physicians' services are received is higher among the aged not only as compared with all HIP members but also as compared with any other 5-year age group (see chart). The high rate at the older ages, however, does not represent a sharp departure from the experience at earlier ages, but rather is the end point of an upward trend in the rate after ages 35-39.

This difference between older persons and others in physician utilization is a decided change from the experience of HIP in 1948 and 1949. During this early period, the aged received physicians' services in HIP at only a

slightly higher rate, about 10 percent, than all members (6). The 1948-49 experience may have been strongly influenced by special factors applicable to the first few years of the plan, for example, greater dependence of the members on physicians not in HIP than is true today.

Utilization of physicians' services differs among men and women 65 years and over. At these ages a higher proportion of the women than of the men see a doctor during the year, but the relative volume of services is greater among the men. Among all other adults the rate at which women see a doctor is either the same as for men or higher. Actually, the rate for women in HIP is greater at the high fertility ages of 20-29 than at the advanced ages. Among adult males the rate at ages 65 and over is far above that at any other age.

Particularly illuminating are the figures in table 4 on physician visits for two categories of the aged, those who have converted to individual contract and those under group contract. Utilization, it will be noted, is much higher in the former group (who are older on the average) with respect both to the proportion who see a physician during the year and to the average number of such visits. This type of differential is not peculiar to the aged; as indicated by the data for those under 65. It may result

Physician visit rates by age and sex of HIP member, 1955-56

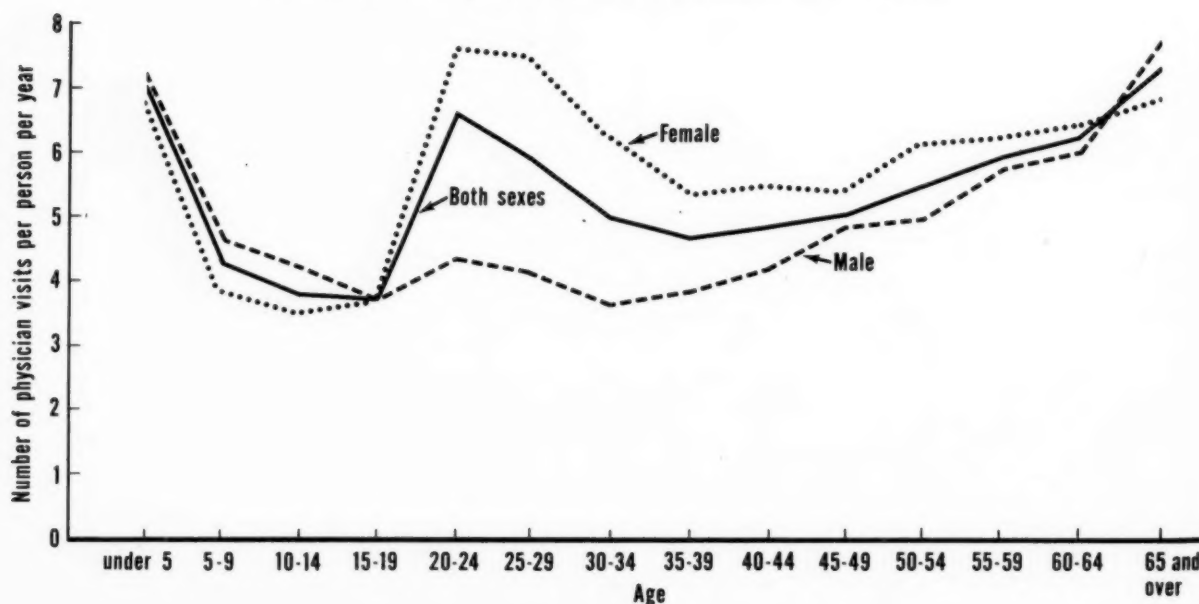


Table 5. Physician visit rates by type of physician for HIP members of specified age and enrollment status, 1955-56

Type of physician	Number of physician visits per 100 persons per year									
	All members					Individual contract by conversion			Group contract	
	All ages	Under 15	15-44	45-64	65 or over	All ages	Under 65	65 or over	All ages ¹	65 or over
All physicians ² -----	517.4	504.5	494.2	552.0	732.0	748.2	730.5	931.6	504.7	686.1
Family physician ³ -----	298.2	386.8	237.7	289.2	405.4	416.9	406.4	529.7	291.7	376.8
Internist-----	19.5	2.1	14.7	40.7	63.3	36.9	31.5	80.5	18.5	59.4
Ophthalmologist and otolaryngologist-----	32.9	28.2	28.3	43.2	55.8	40.1	37.2	60.5	32.5	54.7
Radiologist-----	40.3	20.9	42.8	55.9	55.2	48.7	46.7	64.6	39.8	53.0
Surgeon-----	24.1	10.6	23.6	37.7	47.2	37.1	34.7	59.6	23.4	44.3
Urologist-----	7.7	3.0	4.5	13.8	46.4	14.1	8.9	53.4	7.4	44.8
Orthopedist-----	15.8	15.7	12.8	19.8	23.5	26.0	26.2	26.6	15.2	22.8
Dermatologist-----	13.5	9.8	15.1	14.8	16.5	18.1	17.6	22.8	13.2	15.1
Allergist-----	20.1	20.3	24.6	15.3	5.6	25.5	27.9	10.7	19.8	4.4
Obstetrician-gynecologist-----	41.4	5.5	86.9	14.5	5.3	78.0	88.0	5.4	39.4	5.2

¹ Rates for persons under 65, not shown separately, closely approximate the rates for all ages.

² Includes specialists not shown separately.

³ Includes pediatricians' services. Exclusion of these

services reduces the family physician rate for all persons to 243.8 and the rate for children under 15 to 196.8.

NOTE: Data based on a 10 percent sample of the HIP enrollment.

to a considerable extent from self-selection on the part of a subscriber, whether or not aged, when faced with a choice of converting to individual enrollment or dropping his insurance.

In view of the comparatively high requirements among the aged for physicians' services, the question might well be asked, what would happen to the volume of physician services in HIP if the aged were represented in the plan in the same proportion as they are in the general population? Some indication of the result can be obtained if it is assumed that (a) the rate of visits found among the aged on group contract is applicable to all the aged in the city's labor force and (b) the rate for those who converted to individual contracts is applicable to all of the noninstitutionalized aged not in the labor force. Under these assumptions, increasing the proportion of the aged in HIP from 3.6 percent to 9.1 percent would raise the average number of physician visits per member per year from 5.2 to 5.5.

The impact of this relatively small increase on the operations of a medical care plan may not be reflected entirely by what happens to the overall rate. A full assessment would require, among other things, currently unavailable data

on ancillary services to the aged and knowledge about the kinds of physicians' services this age group receives. The latter is discussed in the sections that follow.

Specialists' Services

Associated with each medical group in HIP are physicians in 12 basic specialties. The opportunity to call on a specialist is one of the most important advantages of the plan both to the member and to his family physician.

As medical problems vary with age, so do requirements for services from specialists. Throughout adult life, visits to all but a few of the specialists increase to reach a peak among the aged (table 5). Utilization of surgeons, internists, and urologists is especially high at ages 65 and over as compared with the rates for all ages combined.

Paralleling the increase in the requirement among the aged for care from the specialist is the greater volume of services that the family physician is called on to give. While the average number of visits to the family physician for older persons is 4.1, the corresponding figure for adults in each of the 2 age groups shown in table 5 is less than 3.0 per person.

The pattern of utilization of medical services is very similar among men and women 65 or over in a number of important respects. The rates for the two sexes are virtually the same in the use of family physicians, ophthalmologists and otolaryngologists, and radiologists (table 6). However, the men have a substantially higher rate of service from the internists and, of course, from the urologist, while women see the orthopedist more often.

No specialty can be identified as bearing a particularly heavy part of the greater utilization by the aged who have converted to individual contract as compared with the aged under group contract. The rate at which general physicians are used increases by about the same proportion as the rate for all services, and major increases occur in a wide range of specialties, including internal medicine, surgery, and radiology.

Place of Service

The proportions of physician visits that take place in the office, in the home, and in the hos-

pital differ greatly according to age. The outstanding characteristic of the pattern among the older people is the exceptionally high proportion of visits in the hospital, 21 percent as compared with 11 percent for all ages. The difference is even greater on a rate basis. Services in the hospital are received from HIP physicians by the aged at the rate of 154 per 100 members, which is almost three times the rate of 57 for all persons in HIP (table 7). Contributing to the high rate for the aged are both high hospital admission rates and long hospital stays (table 8).

The average number of visits to the physician's office is likewise greater among those 65 and over, but the margin is far smaller than is found in hospital care. Although the home call rate for the aged is higher than for other adults, it is slightly below the rate for persons of all ages, which is affected markedly by frequent home visits to children.

Among the aged, men utilize physician services in the hospital at an appreciably higher rate than do women (table 7). The differential

Table 6. Physician visit rates by type of physician for HIP members of specified age, sex, and enrollment status, 1955-56

Type of physician, by sex of HIP member	Number of physician visits per 100 persons ¹ per year						
	All members		Individual contract by conversion			Group contract	
	All ages ¹	65 or over	All ages	Under 65	65 or over	All ages ¹	65 or over
Males²	481.4	759.7	681.2	629.1	1,075.0	471.1	703.0
Family physician ³	292.4	409.5	410.0	387.7	593.6	286.4	376.3
Internist	21.4	66.6	34.0	25.8	87.9	20.8	62.8
Ophthalmologist and otolaryngologist	32.9	55.5	36.8	33.3	58.9	32.7	54.9
Radiologist	38.9	56.6	46.2	43.0	68.2	38.6	54.5
Surgeon	27.1	54.3	41.6	35.6	86.8	26.4	48.4
Urologist	12.2	67.7	25.3	14.6	95.7	11.5	62.7
Orthopedist	15.7	16.2	25.5	26.2	23.2	15.2	14.9
Females²	554.5	678.9	809.3	820.0	765.7	539.6	649.5
Family physician ³	304.2	397.5	423.2	423.0	455.8	297.2	377.8
Internist	17.5	57.0	39.6	36.6	71.9	16.2	52.0
Ophthalmologist and otolaryngologist	32.8	56.3	43.0	40.7	62.4	32.2	54.3
Radiologist	41.6	52.5	51.0	50.0	60.3	41.1	49.8
Surgeon	21.0	33.6	32.9	33.8	28.1	20.3	35.4
Urologist	3.2	5.6	3.9	3.9	4.5	3.2	6.0
Orthopedist	15.8	37.5	26.4	26.2	30.6	15.2	39.9
Obstetrician-gynecologist	82.2	15.3	144.8	160.6	11.6	78.6	16.6

¹ Rates for persons under 65, not shown separately, closely approximate the rates for all ages.

² Includes specialists not shown separately.

³ Includes services by pediatricians. Exclusion of

these services reduces the family physician rate for all males to 235.3 and for all females to 252.5

NOTE: Data based on a 10 percent sample of the HIP enrollment.

is due entirely to a wide gap in hospital admission rates for the two sexes, the average length of stay being virtually the same. The

relationship between the rates of service in the hospital for men and women is not repeated for services in the office or at home. In fact,

Table 7. Physician visit rates by place of service for HIP members of specified age, sex, and enrollment status, 1955-56

Place of service, by sex of HIP member	Number of physician visits per 100 persons per year									
	All members					Individual contract by conversion			Group contract	
	All ages	Under 15	15-44	45-64	65 or over	All ages	Under 65	65 or over	All ages ¹	65 or over
Both sexes	517.4	504.5	494.2	552.0	732.0	748.2	730.5	931.6	504.7	686.1
Office.....	408.9	358.3	411.6	453.1	530.1	564.9	558.2	643.9	400.3	503.9
Home.....	51.8	115.0	25.3	25.8	48.4	73.8	75.2	69.3	50.6	43.5
Hospital.....	56.7	31.3	57.3	73.1	153.5	109.5	97.1	218.4	53.8	138.6
Males	481.4	535.7	388.2	522.1	759.7	681.2	629.1	1,075.0	471.1	703.0
Office.....	380.9	379.7	342.2	420.8	535.6	517.9	494.6	697.9	373.9	506.4
Home.....	51.4	119.8	21.7	22.8	43.3	68.9	72.5	53.2	50.5	41.5
Hospital.....	49.1	36.2	24.3	78.5	180.8	94.4	62.1	323.9	46.7	155.0
Females	554.5	471.3	589.7	586.8	678.9	809.3	820.0	765.7	539.6	649.5
Office.....	437.7	335.4	474.2	490.7	519.5	607.9	614.4	581.4	427.7	498.6
Home.....	52.2	109.9	28.4	29.3	58.0	78.2	77.6	88.0	50.7	47.8
Hospital.....	64.6	26.0	87.1	66.8	101.4	123.2	128.0	96.3	61.2	103.1

¹ Rates for persons under 65, not shown separately, closely approximate the rates for all ages.

NOTE: Data based on a 10 percent sample of the HIP enrollment.

Table 8. Hospital admission rates and average length of hospital stay for HIP members, by age and sex, 1955

Age	Both sexes		Males	Females	
	All ad- missions	Nonobstet- rical admissions		All ad- missions	Nonobstet- rical admissions
<i>Hospital admission per 1,000 persons</i>					
All ages ¹	77. 4	59. 6	54. 0	101. 2	65. 2
15-44.....	93. 2	57. 0	40. 4	154. 3	71. 6
45-64.....	79. 1	79. 1	71. 9	87. 6	87. 6
65 or over.....	121. 2	121. 2	131. 0	102. 0	102. 0
<i>Days in hospital per admission</i>					
All ages ¹	7. 6	8. 1	8. 8	6. 9	7. 6
15-44.....	6. 5	7. 0	7. 5	6. 2	6. 8
45-64.....	11. 0	11. 0	11. 9	10. 2	10. 2
65 or over.....	13. 2	13. 2	13. 4	12. 6	12. 6
<i>Days in hospital per 100 persons</i>					
All ages ¹	58. 8	48. 6	47. 6	70. 3	49. 6
15-44.....	65. 3	40. 0	30. 4	96. 1	48. 5
45-64.....	87. 3	87. 3	85. 3	89. 5	89. 5
65 or over.....	159. 5	159. 5	175. 7	128. 0	128. 0

¹ Includes hospitalizations of children under 15.

SOURCE: Prepaid Medical Care and Hospital Utilization, by Paul M. Densen, Eve Balamuth, and Sam

Shapiro, Hospital Monograph Series No. 3, Chicago, American Hospital Association, 1958.

care in the home is received relatively more often by aged women than by aged men.

As pointed out previously, among members both over 65 years and under that age those who have converted to individual contract use physician services at a considerably higher rate than the group subscribers. This difference results from more frequent use of physicians' services not only in the office but also in the home and in the hospital (table 7).

One of the most interesting utilization experiences among the aged converttees is the rate at which the men receive physician services in the hospital. This figure (324 per 100 persons per year) is more than twice the rate among aged men under group contract (155) and several times the average for HIP as a whole (57).

Hospitalized Surgery

The rate of operations performed in the hospital is higher for the aged (45 per 1,000 persons per year) than for all HIP (35 per 1,000) (table 9). The differential is far smaller than that in the rate for all hospital admissions, but it represents a difference of 27 percent, a not inconsequential margin.

The surgery rate is comparatively high in the aged group mainly because of the high rate for men. The rate for aged women (36 per 1,000) is near the average for all females (34) and, in fact, is slightly lower than that for other adult females. On the other hand, the rate for aged men (50) is well above the figure for men at younger ages.

Unlike other categories of utilization, hospitalized surgery for the aged is not more frequent among the converttees than among persons covered by group contracts. The rates are nearly the same, 43 and 45 per 1,000 respectively.

Requirements for surgery are only partly defined by total rates. Detailed data regarding operative procedures are needed for complete analysis. Only a few such data are now available. As indicated by the rates in table 9 for broad categories of procedures, the aged differ substantially from persons of all ages in the types of operations they undergo.

Gastrointestinal, abdominal, and genitourinary operations account for about three-fifths of the hospitalized surgery among the aged as compared with two-fifths of the surgery at all ages. Furthermore, from the limited data

Table 9. Hospitalized surgery rates for HIP members, by type of operation and age and sex, 1956

Type of operation, by sex	Number of operations per 1,000 persons per year				
	All ages	Under 15	15-44	45-64	65 or over
Both sexes	35.3	40.2	30.6	36.7	44.7
Eye, ear, nose, and throat	6.5	17.3	2.0	2.3	5.0
Gastrointestinal and abdominal	7.6	4.9	6.3	11.8	13.1
Genitourinary	6.4	14.6	1.6	4.5	13.1
Obstetrical-gynecological	6.4	(¹)	11.3	6.5	2.0
Orthopedic	2.0	1.7	1.9	2.4	2.8
Other	6.3	1.8	7.5	9.2	8.7
Male	² 36.5	² 57.3	20.9	34.7	49.5
Eye, ear, nose, and throat	7.4	18.0	2.9	2.8	5.1
Gastrointestinal and abdominal	9.7	7.1	7.6	14.9	14.1
Genitourinary	³ 11.6	³ 27.9	1.8	6.7	18.7
Orthopedic	2.2	2.4	2.1	2.2	2.3
Other	5.7	2.0	6.4	8.1	9.3
Female	34.1	22.1	39.2	38.9	36.1
Eye, ear, nose, and throat	5.7	16.6	1.3	1.8	4.8
Gastrointestinal and abdominal	5.4	2.5	5.3	8.3	11.3
Genitourinary	1.3	.3	1.3	2.2	3.1
Obstetrical-gynecological	12.9	(¹)	21.2	13.5	5.5
Orthopedic	1.7	.9	1.6	2.7	3.8
Other	7.0	1.6	8.6	10.3	7.6

¹ Rate is less than 0.1.

² Includes circumcision of newborn. Exclusion of these procedures reduces the rate for all males to 29.4, and the rate for males under 15 to 32.8.

³ Includes circumcision of newborn. Exclusion of

these procedures reduces the rate for all males to 4.4 and the rate for males under 15 to 3.5.

NOTE: Data based on a sample consisting of all operations performed in hospitals during alternate months in 1956.

available, it appears that the nature of the operations within broad categories differs with age. This is illustrated most clearly with respect to eye, ear, nose, and throat operations. In this category two-thirds of the operations among the aged are for cataract and glaucoma (3.4 per 1,000 persons over 65) whereas at younger ages by far the most frequent surgical procedure is tonsillectomy (5.0 per 1,000 persons under 65).

Summary and Discussion

The enrollment and medical care experience of the aged in the Health Insurance Plan of Greater New York has been examined from a number of standpoints bearing on current discussions of health insurance for the aged. In generalizing it is important to keep in mind the characteristics of this medical care plan. It is prepaid, comprehensive in coverage for all medical services, and it provides care through medical groups. There are no restrictions on enrollment because of age or preexisting conditions. Initial enrollment is principally through employment groups, but subscribers leaving their groups have an unrestricted privilege of converting to individual contract.

The outstanding feature of HIP's enrollment experience with aged subscribers is that despite the conversion privilege most of those who must decide whether to convert or to terminate coverage drop their insurance. This situation illustrates the paradoxical position of many members of health insurance plans when they reach retirement age. Group coverage is obtained while they are employed and for an increasing proportion of them under arrangements whereby the employer or a health and welfare fund pays at least part of the premium. On leaving employment, many of the subscribers are faced with the dual economic problem of reduced income and increased out-of-pocket costs to maintain their insurance. And this occurs at a time when their medical needs are increasing. A pertinent question for the community is where and how do the aged whose health insurance is terminated obtain medical care. It would be of much interest, for example, to determine the extent to which former HIP enrollees become dependent on hospital clinics and ward facilities.

With respect to the medical care requirements of the aged, HIP's experience affords several observations:

1. The aged see a physician on the average considerably more often than do persons of all ages combined. The rates are 7.3 physicians' visits per member per year for the aged and 5.2 for the total enrollment. The older people who have converted to individual contract average 9.3 visits to a physician per year.

These rates are unquestionably high, but they are not quite so forbidding when it is realized that the rates are also high in other age groups (60-64, 20-29, and under 5 years). Viewing voluntary health insurance as a community institution, it is appropriate to consider what would happen if the aged were represented in HIP in the same proportion as in the total population. In New York City, this would mean an increase in the aged subscribers from 3.6 to 9.1 percent, and an estimated rise in the rate of physician visits of 6 percent (provided the aged added to HIP were representative of all the noninstitutionalized aged in the city). This is a small quantitative increase, but its true impact on the medical care plan cannot be fully assessed without information about the qualitative aspects of the care received by the aged.

2. Most of the medical specialties are affected by the comparatively high medical requirements of the aged. The greatest effect is on the surgeon, the internist, and the urologist. Of equal significance is the fact that the family physician continues to occupy a central position in providing medical care to the aged. Thus an increase in enrollment of the aged would require not only an expansion, in varying degrees, in some of the specialties but also the addition of family physicians.

3. Extensive use of hospital care is a major reason for the comparatively large volume of physicians' services received by the aged in HIP. More than a fifth of the contacts the aged have with the physician (21 percent) take place in the hospital; the corresponding figure for members of all ages is 11 percent. A higher surgery rate is an important factor in this situation, although there are indications that admissions for services other than surgery contribute more to the high hospital rate. The type of operation performed on the aged differs from

the type for younger persons. This may have greater bearing in evaluating the surgical requirements of the aged than the general rates of operations performed. A full exploration of this point is dependent on the development of data concerning specific operations.

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Arthur S. Flemming, Secretary

Marion B. Folsom, Secretary of Health, Education, and Welfare, resigned from his post July 31, 1958. Mr. Folsom became Secretary August 1, 1955, after having served as Under Secretary of the Treasury for 2½ years.

He had previously been active in social security programs for more than 25 years.

In 1928, he developed a life insurance, retirement, and disability plan for employees of Eastman Kodak Company and 3 years later Mr. Folsom developed an unemployment benefit plan which included 13 other companies in Rochester, N. Y.

His work in Federal social security began with membership on the President's Advisory Council on Economic Security which helped draft the original Social Security Act in 1934.

In 1942 he helped organize the Committee for Economic Development, of which he later became chairman, and in 1944-46 he served as staff director for the House Committee on Postwar Economic Policy and Planning.

During his tenure with the Treasury Department, he worked with the Department of Health, Education, and Welfare on a study of old-age and survivors insurance resulting in extension of coverage and liberalization of benefits under the 1954 amendments to the Social Security Act.

Arthur S. Flemming, president of Ohio Wesleyan University since 1948, succeeds Secretary Folsom. While on leave from his university post, Mr. Flemming served as director of the Office of Defense Mobilization, during 1953-57, and as assistant to the Director of that agency in the years 1951-53.

A member of the United States Civil Service Commission during 1939-48, he was also chief of labor supply in the Office of Production Management in 1941-42, chairman of the Management-Labor Policy Committee of the War Manpower Commission during the next 4 years, and on the Manpower Survey Board of the Department of the Navy in 1943 and 1944.

Mr. Flemming was twice a member of the Commission on Organization of the Executive Branch of Government, during 1947-49 and again in 1953-55, and served as chairman of the Advisory Committee on Personnel Management of the Atomic Energy Commission from 1948 to 1953. He has been a member of the International Civil Service Advisory Board since 1950 and of the President's Advisory Committee on Government Organization since 1953.

From 1930 to 1934, Mr. Flemming was on the editorial staff of the publication now known as the *U. S. News & World Report*.

Nursing Home GOALS

The First National Conference on Nursing Homes and Homes for the Aged, called by the Public Health Service, was held February 25-28, 1958, in Washington, D. C. Some 150 persons, representing individual homes, social service organizations, State health and welfare departments, and 32 national associations met to discuss measures for improving services to the chronically ill and aged. The goals set by the participants, their recommendations on how these goals can be reached, and three of the addresses at the conference are summarized on the following pages. The full proceedings are being published by the Public Health Service.

Achieving the Goals

The Federal role in achieving the goals of this conference is necessarily an auxiliary one, affording certain aids and opportunities that are valuable only to the extent that they are used, creatively and imaginatively, by the States and communities. A review of current activities of the Public Health Service and other units

This summary is based on a paper presented by David E. Price, M.D., chief, Bureau of State Services, Public Health Service.

of the Department of Health, Education, and Welfare as they relate to these goals may spark your thinking on ways you can use existing aids to greater advantage and suggest to you recommendations for additional activity which we could legitimately undertake.

Goal 1. Several national studies, completed, in progress, or planned, should help to advance this goal. One of them, already published, is especially pertinent: *Nursing Homes, Their Patients and Their Care*. Knowing the characteristics of the people in these homes is an important first step toward determining the services and facilities they require.

Other studies now under way, such as the U. S. National Health Survey which began in July 1957, and the sample survey of Old Age and Survivors Insurance beneficiaries which will be conducted this year, can be expected to give us additional data that will be helpful.

Goal 2. Perhaps the most notable contribution the Federal Government has made in this area is the so-called standard-setting amendment to certain public assistance titles of the Social Security Act. Prior to this legislation, there was no way substandard homes could be forced to provide at least the essentials of decent living for older people. Now, all States have regulatory authority over most types of homes even though all States do not have it for all types of homes. Licensing authorities in both the State welfare departments and the State health departments have recognized that the most important contribution they can make to the improvement of services is not through the use of police power, but through the assistance they can offer home operators.

Goal 3. The Federal Government has been active in many facets of the knotty financial problems involved in improving the services and facilities of nursing homes.

The Hill-Burton program provides a strong financial incentive to States and communities to create much needed facilities. Since 1955, about \$21 million in matching funds have been provided annually for construction of facilities primarily serving patients with long-term illnesses. Four hundred projects, adding 3,900 chronic disease beds, 4,500 nursing home beds, and other facilities, were aided by these special funds.

Public assistance financing has also been liberalized. Legislation in 1956 not only increased the Federal share in assistance payments but also provided a separate formula and additional funds for medical care.

Here again, however, there are wide variations in the value an area receives for its Federal aid dollar. For example, with the constantly increasing number of older people in the population, general hospitals, planned, staffed, and organized to provide costly care for patients with acute illness, find that more and more of their beds are occupied by long-term patients.

Conference Goals

1. To determine the essential elements of service in the different classifications of homes.
2. To delineate more clearly ways in which accrediting, standard-setting, and regulatory agencies may assist in improving the quality of care in nursing homes and homes for the aged.
3. To encourage a more realistic attitude in financing the cost of facilities and services provided by nursing homes and homes for the aged.
4. To explore the need for and methods of providing public, professional, patient, and family education.
5. To explore ways and means of providing consultative services and assistance to administrators and staffs of nursing homes and homes for the aged.
6. To set guidelines for future action.

Many of these same patients could be cared for at far less cost in nursing homes where medical care is available.

Similarly, public assistance payments for medical care are often much higher than they would need to be if the community were willing to invest more in public health programs that prevent the development of chronic diseases, retard their progress, and minimize their effects. Multiple screening projects for the early detection of chronic conditions would reduce the need for institutional care. Rehabilitation programs, planned cooperatively by health and welfare agencies, hospitals, homes, and physicians, would help to reduce the time period when costly medical and nursing care is required.

Goal 4. In the field of professional education, we can already count solid gains: the Public Health Service traineeship programs for nurses and public health personnel into which some \$5 million is being invested this fiscal year and the authorization for a program of grants to States for extending the number of trained public assistance personnel, to mention only two of the most recent ones.

Another educational approach is through publications. For example, there is now available an illustrated booklet showing in detail the exercises that will help stroke patients. This will make it possible for the general practitioner, his patient, and the patient's family to work out a regimen of exercises. The new diet booklets prepared for heart disease patients on sodium-restricted diets, sponsored by the Public Health Service and a number of voluntary and professional agencies, are designed for the same type of use. Other examples are the manuals *How to be a Nursing Aide in a Nursing Home*, produced cooperatively with the American Nursing Home Association, and *The Older Person in the Home*, and, of course, the periodical *Aging* which is issued by the Department's Special Staff on Aging.

Goal 5. The Public Health Service last year received from Congress an additional \$3 million in general health grants to assist States to develop programs in chronic disease and other health areas not covered by the traditional type of public health activity. A gratifying number of States elected to use their share of this fund to strengthen their consultative services to nursing homes. Altogether, 75 percent of this fund has gone into chronic disease and health of the aging programs.

Other units of the Department have also taken measures to strengthen their service component. The Bureau of Old-Age and Survivors Insurance, for example, has recently established a welfare branch to help its field staff give better service to OASI beneficiaries who consult them about nursing homes and other personal problems. Recent public assistance legislation encourages welfare agencies to extend their social services to older persons, a significant step because social problems are quite as important as medical problems. The well-balanced nursing home program makes provision for dealing with both.

Goal 6. I hope this partial review of Federal programs will prove of some value to you in achieving your final goal of setting guidelines for future action. For any Federal effort to be meaningful, it must be backed by local action. Every type of Federal aid, to be of

real value, must evolve from firm roots in local soil; otherwise you may have paper progress, token action, but you will not really change the lives and outlook of the rapidly growing millions of the very old.

This First National Conference on Nursing Homes and Homes for the Aged will indeed become historic if it marks the beginning of a concerted drive to give our chronically ill and aged the kind of care that each of us would hope to have when it comes our time to enter into that final stage of life.

The Heart of the Matter

In a certain nursing home lives a little old lady, aged 90 years, a former school teacher. She is happy, active, comfortable, busy with crossword puzzles, books, and newspapers. She takes a daily walk around the block with the aid of her aluminum walker and watches the world go by from her cheerful front-room window.

A year ago, she was alone in the world, living in a house that had been her home for nearly 50 years. When a severe stroke crippled her, she was living in squalor, helpless in an unheated room. The postman missed her usual greeting one day, and getting no response to his knock, he summoned the police. After a few weeks in the hospital, she was removed to a nursing home.

There, with skilled care under a physician's supervision, she was restored to her present state of self-care, better health, comfort, and good spirits. Her pension and funds from the sale of her house assure her good care in the nursing home as long as she lives. Her remaining years will be far happier there than in any other setting.

She (with some 300,000 others in nursing homes and homes for the aged) is the focal point of your deliberations. Never lose sight of her, or her counterpart in some home known to you.

It is not easy to keep focused on the human factor. We deal with scores of impersonal

This summary is based on remarks by Leroy E. Burney, M.D., Surgeon General of the Public Health Service.

factors. Physicians may tend to think of diseases and diagnoses, administrators of programs and procedures, nurses of medications and supervisory problems, social workers of caseloads and therapeutic interviews.

But if we think exclusively of our own little specialties, we do so at the peril of the people we serve. For although each of us makes a necessary contribution, no one has all the knowledge, the skills, and the resources to place and maintain this elderly, retired school teacher in her present happy state.

Nor can we think exclusively of our particular zones of responsibility, whether it is national, State, or local. What is done or not done in each zone, in the national agency, the State, the community, and the nursing home affects in some degree all other zones. And this in turn affects for better or worse the people in nursing homes and homes for the aged. We who have any kind or degree of responsibility for the well-being of aged people cannot afford to let a colleague's efforts go unmarked with respect, his successes without rejoicing, nor his failures without prompt help.

Kaleidoscope of Health Services

There is no ideal pattern for nursing homes and homes for the aged in the kaleidoscope of health services for older people. The health services that older people require, like the bits of colored glass in a kaleidoscope, can be arranged in an endless variety of harmonious, effective patterns to suit the circumstances of any individual, any family, any community, or any State. The nursing home is just one piece, and its place in the pattern depends on the availability and quality of other health services for the aged.

This is a vast kaleidoscope, and we must keep our eyes on single bits of this pattern which concern this conference. We must seek a common vantage point from which we can describe the place of the homes and their quality in practical terms as realistic goals for every institution, community, State, and national organization.

Facilities and services that permit better care of older people are at the center of the larger

problems of aging. This lack keeps tens of thousands of older patients in general hospitals when they no longer need full hospital services. The lack of enough high-quality nursing homes and homes for the aged, or their equivalent, places persistent, exorbitant demands upon many communities for additional general hospital beds and drives up the costs of hospital care. The lack of high-quality institutions to serve the aging population thus denies good hospital care to thousands.

According to the first estimates of the U. S. National Health Survey, about 1,800,000 men and women over 65 years are unable to carry on their normal family and vocational activities because of chronic conditions. I do not imply that all of these should be in nursing homes or homes for the aged. But among them are many whose families cannot afford skilled care at home, many who are eking out a lonely, marginal existence, and many whose illness contributes to dependency because an employed member of the family must give up a job to care for an invalid. We have reason to be disturbed about the dollar price of our neglect of health services for the aged; it touches everyone's pocketbook.

Personal Concern

More important, we care about people. The past 20 years have dynamically changed the whole fabric of our society. But another sort of change, hard to define and springing in part from these dynamic processes, is becoming widespread. It might be called the depersonalization of society. Industrial automation and its counterparts in family life have removed large segments of the population from direct participation in basic communal activities. Decisions affecting the entire population are made by a relatively few people far from the local community. As cities absorb neighboring rural areas, distances from residential areas to the center of community decision increase. The migration to the suburbs is depriving the central city of much of the personal concern of its leadership. Not only in metropolitan areas but in the burgeoning smaller cities community

functions tend to become concentrated in the hands of a few.

This aspect of depersonalization should be a

continuous warning light to the health and welfare professions. In making community decisions leaders in these fields should be severely

Nursing Home FACTS

TYPES OF HOMES

Proprietary. Operated under private, commercial ownership.

Public. Operated under State or local governmental auspices.

Voluntary. Operated under private, nonprofit auspices, such as church and other groups.

Skilled nursing. Provides as its primary function skilled nursing care, including procedures which require technical nursing skill beyond that of the ordinary untrained person.

Personal care (with skilled nursing). Provides some skilled nursing care, but only as an adjunct to its primary type of services.

Personal care. Provides such personal services as help in walking, getting in and out of bed, bathing, dressing, and feeding and supervision of self-administered medications.

Shelter. Provides room, board, and minimum services of a domiciliary nature such as laundry, personal courtesies, and occasional help with tasks such as shopping and correspondence.

THEIR NUMBERS

There are an estimated 25,000 nursing homes and homes for the aged in the United States.

They contain 450,000 beds, 180,000 in skilled nursing homes, and 80,000 in homes that provide some skilled care.

Ninety-one percent of the nursing homes are privately owned; three percent are publicly owned. The publicly owned homes have 15 percent of the beds, an average of 69 each; privately owned homes average 18 beds each.

Nursing homes are licensed by every State and Territory except Puerto Rico and the Virgin Islands; only Puerto Rico, the Virgin Islands, and South Carolina do not license homes for the aged. State agencies responsible for licensure programs are:

Type of agency	Nursing homes	Homes for the aged
State and Territorial health departments	42	34
State welfare departments	6	14
Other State agencies	3	2
None	2	3
Total	53	53

The demand for nursing homes is growing. At present 15 million Americans are more than 65 years of age, and by 1975, there will be 19 million. The control of infection, higher standards of living, and improved medical and hospital care are contributing to the longevity and growth of the population of oldsters.

THEIR RESIDENTS

Nursing home residents have an average age of 80 years; two-thirds of them are more than 75 years old. Two-thirds of them are women. Two-thirds have some circulatory disorder. Less than half can walk alone. About one-third are incontinent. More than half have periods when they are disoriented.

Their care costs an average of \$150 monthly. Public funds pay for the care of 50 percent of nursing home residents, and public assistance payments range from \$55 to \$155 per month.

These definitions and data were obtained from Public Health Monograph No. 46, *Nursing Homes, Their Patients and Their Care*, by Jerry Solon, Dean W. Roberts, Dean E. Krueger, and Anna Mae Baney, 1957.

self-critical lest we fall into the delusion that we are the community.

A major contribution of this conference can be to lift the deadening hand of depersonalization from planning and programs for the aging throughout our country. In doing so we would release the most powerful force that mankind has developed, the force of human affection and personal concern.

To do this, we need to touch base with the realities of the problems we hope to solve; to draw upon the experience of the frontline workers in our midst.

I come back to the little old lady in the nursing home. By keeping her in the center of our thinking, we find that the patient is often the first obstacle. Don't think she wears a halo. A person so resistant to change is not easy to help.

Many older people seem to withdraw progressively from the world around them. Their perception of themselves and others and their responses seem to grow less acute. When illness comes, the benefits of medical, psychological, and social treatment are more difficult to achieve. The family may also be an obstacle to better care and better health of an older person.

The community, however, is the greatest obstacle to better care and better health of the aging in these homes. By its collective attitudes and its resistance to change, the community places these institutions in the same withdrawn situation that characterizes so many of their residents. The community has allowed the remarkable scientific and technical advances of this century to bypass nursing homes and homes for the aged.

Deeply rooted in the community consciousness is the age-old dread of institutions. In the 19th century the hospital, as well as the nursing home, the county farm, or the old folks home, was a place for the sick poor to go to, and die. Advances in medicine, psychiatry, sociology, architecture, equipment, and personal services have revolutionized the community general hospital and made it a place where all classes go, and live. These advances are applicable to the nursing home and the home for aged, as many existing institutions have demonstrated.

Our main task is to find ways that will make all nursing homes and homes for the aged places for all classes to go and live.

State and Local Progress

Despite overwhelming handicaps, the State and local official agencies that license nursing homes and homes for the aged are making great progress. But there is much more progress to be made. Moreover the official agencies alone cannot improve the operation and the quality of patient care in these institutions.

Primary responsibility for the licensure of nursing homes and homes for the aged rests with the State health department in most States. Moreover the health departments are usually consulted in the States where some other department handles licensure. Within the State health departments, however, administrative patterns for licensure vary. But the majority of the departments have the same overall program director for both licensure and Hill-Burton programs. Usually the licensure unit itself is a small section within a division of the health department. It calls on other parts of the State health department for such services as public health nursing, nutrition, environmental health and safety, and chronic disease.

The licensure of hospitals and the licensure of nursing homes and homes for the aged are handled by separate units in most States, although an increasing number of States are combining their functions in one division.

State agencies are delegating more and more functions to local agencies when the local unit can handle them. States with strong local health departments find that decentralization is effective and that activities relating to the homes can be integrated into regular public health programs.

Other States hold that decentralization to the regional level is best, and some carry on all activities from the State level. Others are still

This summary is based on a paper presented by Bruce Underwood, M.D., consultant in nursing homes, Chronic Disease Program, Public Health Service.

experimenting and trying out various plans. Some understaffed local health departments do not have time to give to programs for the homes. However, it is my impression that whenever local health departments have a major role in these programs, progress is greater. The picture is similar in the States where welfare departments have the licensure function.

There is wide variation in the types of personnel who actually do the inspections and consultations and carry on the programs. The background of these people may be primarily environmental health, architecture, engineering, medicine, nursing, or a combination thereof. Few State licensure agencies have adequate staffs. Consultation services available from or through the agencies are usually meager.

Inspection procedures also vary. In one State, 7 to 9 inspectors from separate agencies must visit the nursing home before a license is issued. In most, one person inspects for the official licensure agency and another for the official fire safety agency. The inspecting agencies usually work well together and with interested voluntary and professional groups, but in a few States there is little cooperation.

Educational Approach

Perhaps the most important trend among the official agencies is the use of the educational approach rather than the big stick of law enforcement. In one county with long experience in licensing, the official inspectors or consultants have good relationships with the homes. Persons who want to open homes are helped if they can meet the standards, discouraged if they cannot. Homes are approached with these questions: How can we help you? What can we do for you? What are your problems? How can they be met?

This county once had a number of homes that didn't comply with the standards. At informal hearings with the administrators of these homes, laws and standards were not emphasized. Rather patients' needs were stressed, a list of necessary items were agreed upon, and a timetable and priorities were established for the most urgent needs. In this way, the homes, agencies, professions, voluntary agencies, and the nursing home administrators came to under-

stand, support, and cooperate with each other. Together they received the all-important backing of public opinion and public understanding as well as the support of appropriation agencies.

This educational approach is being used increasingly all over the Nation. Where it prevails, the State nursing home associations usually want higher standards, stricter enforcement, and more consultative assistance than the official agency can give. In some areas cooperation is so close that official personnel are difficult to distinguish from those of the voluntary agency. Statewide and regional seminars and institutes are jointly planned and conducted.

Signs of the Future

Nursing home laws and regulations are being revised and standards are being raised all over the Nation. The Public Health Service is assisting official agencies by providing consultation of various kinds and making available instructive handbooks. Various laws and regulations on nursing homes and homes for the aged are being compiled. Also under way is the development of definitions and principles for the States to use as a guide for their nursing home laws and regulations.

Some new, exciting developments are indications of the future. In Peoria, Ill., under a project of the Illinois Public Aid Commission, workers have been trained and are visiting nursing homes to teach aides physical and occupational therapy and rehabilitation techniques.

The outlook of the staff in the homes is changing. One of the attendants in one of these nursing homes was asked, "What do you think of this program?" She answered, "It makes me feel good down in my heart." The administrator of that home said, "Our home will never be the same. People are being rehabilitated and returned to self-help at home or in a foster home at the rate of five or six a month."

Efforts are being made in at least one State to set up accreditation programs for nursing homes in addition to licensure. Others are studying operating costs and personnel time. Some States are experimenting with increased payments to nursing homes to employ physical

therapists and occupational therapists to return people to self-help whenever possible. They are finding this program to be more economical in the long run, to say nothing of the humane factors involved. There are many other new developments and activities taking place in our Nation.

The philosophy behind these omens of the

future has been expressed by Dr. Albert L. Chapman, Division of Special Health Services, Public Health Service, in these words, "The hallmark of civilization is a voluntary commitment of time and money to make sure that oldsters, youngsters, and the infirm are not denied whatever benefits and privileges a humane society can endow them with."

Conference Recommendations

General Policy Questions

1. Nursing homes and homes for the aged are and should continue to be administered under public, voluntary, and proprietary auspices. All have a part to play in providing facilities of good quality. In any particular instance, the most desirable sponsor of a facility from the community's point of view is that one which will provide the best quality of care economically.

2. To clarify the functions of nursing homes and homes for the aged, the following fourfold classification of services is recommended. Each successive category encompasses the preceding category and goes beyond to the extent indicated. Homes, whatever their names and auspices, may be characterized according to the level of services provided in these terms of classification.

Services

The descriptions only convey the essential differences among the categories. This should not detract from the necessary focus in each of the categories on the social, emotional, and spiritual needs of the residents as part of providing opportunity for a satisfactory total pattern of living.

Residential services. Encompasses housing, food services, and limited services of a domiciliary nature such as laundry, personal courtesies, occasional help with correspondence or shopping, and an occasional helping hand short of

routine provisions of "personal care."

Personal care. Includes such personal services as help in walking and getting in and out of bed, assistance with general bathing, help with dressing or feeding, preparation of special diet, supervision over medications which can be self-administered, and other types of personal assistance of this order.

Nursing care. Includes services in caring for the sick which require technical nursing skills.

Comprehensive services. Extends the types of care outlined above to emphasize, in addition, social and group-work services, auxiliary medical services and rehabilitation (including psychiatry, physical medicine, and occupational therapy). This multiplicity of services provides full opportunity for a rich, well-rounded living experience in its social and psychological aspects as well as medical and nursing aspects short of hospital care.

Facilities

Corresponding to this classification of services, the following terms are recommended as designations for understanding the type of home, whatever its given name. These types are the residential facility, personal care facility, nursing care facility, and the comprehensive services facility.

It should be recognized that any type of facility need not confine its services to its residents. It may also be open to persons living out-

side the facility who come in for a portion of the day to use its services.

3. Comprehensive planning at the local level should be done in developing new facilities, utilizing existing planning agencies where such exist, or creating a medium for this purpose. Community planning for new facilities should take into consideration the availability of services to assist in care of patients in their own homes.

4. For those persons who can and wish to be cared for in their own or family homes, this "natural" home usually provides the most desirable environment. To help maintain this environment, the community should make available enabling resources such as visiting nurse services, homemaker services, day centers, foster homes, meal-delivery services ("meals-on-wheels"), and so forth. For those persons in this category who are in financial need, the community should provide adequate financial assistance.

5. Government, through its public welfare programs, is in a position to influence the quality of nursing home care. By its frequently inadequate payments for public assistance recipients in nursing homes, government denies to many patients adequate care while it perpetuates the operation of homes at a sub-standard level. Government should provide payments for public assistance recipients in nursing homes in amounts sufficient to assure provision of adequate care.

6. The development of planned cooperative arrangements between hospitals and homes for the aged and nursing homes should be widely and energetically promoted. Such

plans should include arrangements for ready transfer of patients into the hospital and back again as their needs dictate, with full exchange of medical and related information. Arrangements may also be made for bringing the benefit of the hospital's resources to the patient while he is in the home, through use of the hospital's laboratory, radiological, and other direct services, and through consultative services to the patients and the staff by the medical, dental, nursing, dietary, physical therapy, social, and other staffs of the hospital.

7. There is a trend toward establishment of nursing homes under the jurisdiction of hospitals. This is one among many other arrangements for achieving closer relationships between nursing homes and hospitals. This trend should be encouraged, particularly for the benefit of certain types of patients for whom close and continuing medical supervision is most essential.

8. Older people who are ill have changing needs, ranging from full hospital care to assistance in personal care. For those who are not in need of hospital services, the remaining range of services may be provided within a single facility or in several different types of facilities. It is the community's responsibility to assure the availability of

these services and to make possible the ready movement of patients among facilities according to their needs.

9. Voluntary classification and accreditation of nursing homes and homes for the aged have the potential for upgrading standards of care beyond minimum acceptable requirements of licensing programs. It is important that appropriate mechanisms for such an accrediting and classification process be developed.

10. The beginning efforts toward correcting the lack of training of health personnel in the problems of care of chronically ill and aged persons are commended. Extension of undergraduate and graduate education programs in this direction is strongly urged for all professions contributing to care. Nursing homes and homes for the aged should be utilized in such educational programs as appropriate clinical teaching facilities.

11. There is a great need for research and investigation into the many complex problems associated with nursing homes and homes for the aged. Emphasis should be given to expanded programs of study and experimentation directed toward improvement of administration, to provision of health, social, and related services, and to financing of these services and facilities.

ministrators of nursing homes and homes for the aged concerning their programming of medical care.

4. For maximum benefit to patients in nursing homes and homes for the aged, it is recommended that:

- Each patient have his own personal physician and be under continuous medical supervision.

- Every patient have a medical and social evaluation prior to or at the time of admission to establish a specific plan for care and that this evaluation be made a part of the patient's record in the home.

- Every home have an organized plan for the medical care of its patients.

- The frequency of physician visits rests with the personal physician and should be based on the needs of the particular patient.

5. It is recommended that general hospitals and nursing homes cooperate in the development of integrated programs for care of long-term patients.

6. It is recommended that there be further exploration of the development of nursing home facilities as integral units of general hospitals.

7. Colleges of nursing should be encouraged to develop regional conferences on nursing administration in nursing homes and homes for the aged in the various States in cooperation with nursing home associations and State health and welfare departments similar to the pilot project conducted in Pennsylvania, December 9-13, 1957.

8. Nursing services in skilled nursing homes should be under the supervision of a registered professional nurse.

9. Personal care home groups should, as a minimum requirement, have their nursing care supervised by a trained, licensed practical nurse.

10. It is recommended that curriculums in nursing education be enriched to include clinical practice in chronic illness and administrative practice in chronic illness facilities.

11. Since personnel policies have a direct effect on recruitment and retention of qualified personnel, it is recommended that clear, written

Selected Professional Services

1. In order to insure proper placement of the nursing home patient in the facility best suited to his needs, it is recommended that a system of classifying patients be developed which considers diagnosis, type and degree of disability, potentialities for rehabilitation, and medical, nursing as well as other professional service requirements. A beginning has been made in several localities toward developing such a classification, but it is felt that further research is required to refine, improve, and test such a classification system.

2. Every home should have some organized plan for medical supervision in keeping with its size and needs. It is recommended that

every nursing home operator select at least one physician to act as principal medical adviser to advise on medical administrative problems, review the home's plan for medical care, and handle emergencies if the patient's personal physician is not available.

3. The adequacy and effectiveness of medical supervision depend in part upon the relationship that exists between the home operator and the local physicians. Recognizing the need for continued improvement of this relationship, it is recommended that the American Medical Association Committee on Aging continue its efforts to bring about the formation of State and local committees on aging to advise ad-

personnel policies be developed by nursing homes and homes for the aged, including job descriptions, plans for orientation of new staff and provision for inservice education. It is suggested that the American Nursing Home Association give consideration to the development of suggested personnel policies for nursing homes.

12. It is recommended that appropriate groups undertake research projects in nursing homes and homes for the aged to develop criteria for classifying patients according to nursing needs, the levels of nursing personnel required to meet these needs, and the educational programs desirable for each type of personnel needed to provide these services.

13. State licensing agencies should include professional health consultation services for nursing homes and homes for the aged.

14. It is recommended that a study be made to determine the requirements of nursing homes and homes for the aged with relation to supply, availability, storage, dispensing, and supervision of administration of medications. This study should consider providing medications for acute, chronic, and maintenance needs with due regard for all legal and medical requirements.

15. Medication and its administration should be based on the plan of medical care for the patient and the level of nursing services available.

16. Comprehensive dental care has not been readily available to many residents of nursing homes, especially to those in smaller institutions. In most instances, dental treatment has been limited to emergency care for the relief of pain.

Therefore, to stimulate interest in oral health and to improve the quality and quantity of dental care in nursing homes, the following actions are recommended:

- Dental evaluation of patient on admission to be included in the patient record.

- A principal dentist and/or an advisory committee to nursing homes and homes for the aged should be appointed from the appropriate dental society.

- The dental staff of the community hospital or hospitals should organize a liaison committee with the administrators of nursing homes and homes for the aged for dental consultations and service.

- The dental division of the public health agencies should establish a consultant service to nursing homes and homes for the aged.

- The curriculum in dental schools should include instruction in problems of caring for the chronically ill and the aging.

- Research should be conducted to establish dental needs, necessary portable equipment, and appropriate treatment procedures.

- There should be representation of the dental profession on planning committees for nursing homes and homes for the aged.

17. It is recommended that refresher courses and inservice training on dietary service be provided to personnel responsible for inspection of nursing homes and homes for the aged.

18. It is recommended that to meet more adequately the individual needs of patients in nursing homes and homes for the aged, established community agencies jointly undertake a plan whereby specialized professional services in the community are made available to patients in these facilities. Such services might be made available by voluntary or public agencies or both. Services should include occupational, recreational, and physical therapy, and social, nutritional, X-ray, laboratory, pharmaceutical, and dental services. Specific patterns for providing these services will depend on the local situation.

19. It is recommended that central referral and counseling services for the chronically ill and the aged be developed on a community or regional basis with provision for outposts in surrounding local areas.

These services should be provided by skilled professional personnel.

20. Public assistance agencies with support and cooperation of professional and other interested groups should make the utmost effort, as part of their responsibility for providing care for indigent persons, to obtain public funds adequate to provide the recommended services.

These services should be furnished to all patients on the basis of their needs, without regard to the source of financial support or the type of ownership of the institution.

21. One objective of the nursing home is to promote optimal physical and emotional health and to restore and return to his community every individual who has a potential for such restoration. Therefore, it is recommended that:

- Efforts be made to develop within the nursing staff techniques and skills in counseling and in restorative services and to utilize these so that the patient will not remain bedridden unnecessarily.

- Nursing homes adopt a program of restorative care that can be accomplished through a combination of direct services by the staff or by personnel services provided by other community agencies and consultation services. Personnel used for such services should be individuals with recognized professional qualifications who function under specific medical directions.

- The therapist should be a graduate of a school approved by the American Medical Association's Council of Medical Education and Hospitals, and State licensed or registered, if required by the State.

- Those patients with severe disability and rehabilitation potential beyond the capacity of the nursing home should, when possible, be referred to a rehabilitation facility.

Nutrition and Food Service

1. The nutritional needs of persons in nursing homes and homes for the aged should be met in accordance with the National Research Council's current Recommended Dietary

Allowances adjusted for the population concerned.

It is recognized that these allowances may be met by many food combinations designed to meet the

cost and cultural demands of the patients and residents in the homes.

2. The food service in nursing homes and homes for the aged should meet the nutritional needs of the patients and residents through foods. Nutrient concentrates should be given only on the prescription of a physician.

3. Any processed foods served in nursing homes and homes for the aged should be processed by safe and approved methods.

4. The licensing agency should provide ways and means of making it possible for nursing home administrators to put into practice a food service which will meet the Recommended Dietary Allowances. This will involve information on selection and use of kinds and amounts of foods at varying cost levels and use of qualified personnel and/or authoritative materials. Some sources of personnel and materials are official and nonofficial health and welfare agencies at national, State, and local levels; colleges and universities with home economics departments; hospital dietitians and dietetic associations; and Federal, State, and local departments of agriculture and extension services.

5. At least 3 meals per day should be provided with not more than a 14-hour span between a substantial evening meal and breakfast.

6. Food should be prepared in ways that conserve the nutritive value, and it should be suitably cooked for the digestive capacity of the groups served. The food should be served in a manner that will be acceptable to the patients and residents.

7. Table service for the individual or group should be available to all those who can and will eat at a table. Table service should be provided in a manner that will best serve the interests of the patients.

8. Because of the therapeutic value of getting the patient up for meals wherever possible this practice should be followed, whether or not it would affect the classification of the patient or the rate charged.

9. The entire licensing staff of the regulatory agency should be familiar with the criteria for evaluating

the food service and the specific assistance for food service which may be provided to the operator of the home.

10. The licensing agency should assume responsibility for education and training in all phases of food service for all personnel in nursing homes and homes for the aged. Such education and training should include individual and group conferences, on-the-job training, and formal training. Qualified personnel from the following sources could be used: health and welfare agencies, home economics departments of colleges and universities, hospital dietary departments, and departments of vocational education. New and prospective employees in nursing homes and homes for the aged should be included in such programs.

11. Formal training of professional workers concerned with care

of patients and residents of nursing homes and homes for the aged should emphasize geriatrics and especially geriatric nutrition. Furthermore, this recommendation should be relayed to the appropriate organizations and groups responsible for its implementation.

12. Regulations should require that there be made available for review the menus as served, a record of kinds and amounts of food used for a given period of time, and the number of people served during this period.

13. A national project should be conducted to develop a cost accounting system specifically for nursing homes and homes for the aged.

14. Further studies of the nutritional requirements of the aged person in nursing homes and homes for the aged should be encouraged; this recommendation should be referred to properly equipped research laboratories.

Social and Related Services

1. It is recommended that as a basis for sound medical, social, and personal planning for the older individual, there be the recognition that he be enabled through coordinated community efforts and services to remain in his own home as long as this is consistent with his health and welfare.

2. It is recommended that ways be developed to provide information about services and resources to guide the aged and their families to the appropriate service or resource which may best meet their needs. These informational resources could be central referral services, brochures, booklets, and/or other media.

3. It is recommended that in the interest of mobilizing and making available all community resources for the evaluation of the older individual and his needs, emphasis should be placed on the importance of the development and coordination of consultative services at Federal, State, regional, or local levels.

4. It is recommended that the team approach be used in evaluating the individual's health, social, and other related needs, including the involvement of the older individual

and his family in order to do the best possible planning to meet his needs and those of his family.

5. It is recommended that in all applications for institutional placement, the total assessment of the older person's needs and the resources available to meet those needs, be required prior to actual placement in any institutional setting.

6. We recommend acceptance of the basic premise that persons living in institutions have a right to live as fully as possible within the limits of their abilities and within the limits imposed by the group setting. To achieve this end, full utilization of all social and related services of the community is essential.

7. We recommend continuous consultation on social and related services by both regulatory and other public and voluntary agencies to all institutional facilities for older people.

8. We recommend that professional schools include in their curriculums content material emphasizing the social and emotional needs of older people. Professional schools, colleges, universities, and other com-

munity agencies should be encouraged to offer institutes and other inservice training programs with similar content for institutional personnel and others working with older people.

9. We recommend that in every community there be a responsible group, such as the regulatory agency, council of social agencies, or other special group whose function it is to evaluate and interpret to the public the human values as well as the costs of social and related services. Evaluation and interpretation are

necessary if sufficient funds are to be secured and the best possible utilization of these funds is to be assured.

10. We recommend that studies be made by qualified individuals or agencies (voluntary or public) to develop minimum standards for the amount and types of social and related services required by the older person in a crisis and for his long-term requirements. These standards should be related to the size and type of community in which the older person lives.

Environmental Health and Safety

1. Whereas it is the consensus that fire protection in nursing homes for the aged is of paramount importance,

Therefore, it is recommended that the States adopt, as minimum requirements for life safety in these establishments, the current National Fire Protection Association Standards pertaining to nursing, convalescent, and old age homes, and that each State establish a deadline date for the adoption of these standards.

2. Whereas the importance and the use of automatic fire sprinkler systems in all nursing and rest homes and other structures housing the aged and infirm is recognized, and

Whereas it is especially important that such installations be made in rural locations not served by water mains, and

Whereas it is recognized that the installation of sprinkler systems and other safety to life measures present a problem of increasing operating costs, and

Whereas the majority of the patients housed in nursing homes are supported by the community and other public sources,

Therefore, it is recommended that the communities and their legal representatives recognize their responsibility to the aged and infirm to provide funds that will permit the installation of such equipment as necessary safety elements in the adequate housing of such patients.

3. Whereas there is not available

a compilation of all State and local laws, rules, regulations, and methods of enforcement in regard to nursing homes, and

Whereas such information would be of great value as a basis for discussions of standards and for assisting State and local groups in the development of standards,

Therefore, it is recommended that the work of the Public Health Service now being carried out in the compilation of such data be continued and extended to include laws detailing fire prevention and control, and that such a compilation be published and made available to interested groups.

4. Whereas innumerable active and prospective nursing home operators are acquiring or attempting to modify unsuitable facilities,

Therefore, it is recommended that all available means of publicity be utilized by all interested persons or organizations to acquaint the general public with the free consultation services offered by the individual State licensing agencies, and that a compilation of all such consultation services by any governmental or other agency be published for distribution by the U. S. Department of Health, Education, and Welfare.

5. Whereas the dissemination of information among the participants of this nursing home conference has proved most valuable in creating sympathetic understanding of common problems, which gives promise of practical approaches to the solu-

tion of some of these complex and difficult problems, and

Whereas this kind of transmission of information and development of understanding is most urgently needed at local levels where the facilities are being operated and where the laws are being applied,

Therefore, it is recommended that the Public Health Service continue and extend the sponsoring and development of regional conferences at the local level throughout the country, to which are invited personnel representing local groups similar to those participating in this conference and including agencies and organizations having an interest in the regulation of or services to nursing homes, as well as those agencies and organizations providing financial support for individuals cared for.

6. Whereas employees' fire safety training programs are required of hospitals for accreditation, and

Whereas the fire hazards in nursing homes and homes for the aged are generally similar to those existing in hospitals, and

Whereas the universal adoption of fire sprinkler systems is still in the future,

Therefore, it is recommended that this conference advocate that nursing homes and homes for the aged institute employee fire safety training programs.

7. Whereas accident prevention programs and specific procedures designed to avoid accidents in nursing homes and homes for the aged are restricted by a present lack of substantive information,

Therefore, it is recommended that the Public Health Service make known this general situation and advise qualified investigators that morbidity and mortality studies of nursing home accidents will be considered for National Institutes of Health research grants and, further, that State health departments, municipal health departments, medical schools, and schools of public health be specifically contacted in this regard.

8. Whereas several State associations of nursing home owners now operate desirable and effective pro-

grams of self-inspection of members' facilities, and

Whereas in facilities where unsatisfactory conditions are found to exist the several State associations do take appropriate action to have such conditions corrected and when this fails deny or revoke association membership, and

Whereas this program of self-inspection is most beneficial to the welfare of the patients as well as the financial success of the individual nursing home,

Therefore, State nursing home associations are commended for their programs of self-inspection and are urged to continue and strengthen their procedures for corrective action in the case of members who continue to willfully and flagrantly fail to carry out the objectives of good nursing care of the nursing home association.

9. Whereas it is the total care given to the nursing home patients which is of paramount importance to the nursing home operator, the general public, and the State and local agencies responsible for the inspection and licensure of nursing homes and nursing home operators, and

Whereas the development of a mutual understanding between the official agencies and the members of the nursing home industry for the ultimate attainment of an acceptable level of care in nursing homes and a better understanding of the problems involved in this rapidly increasing community responsibility, and

Whereas this goal would be attained more readily if the staff members and the directors of the official agencies responsible for the inspection and licensure of nursing homes were given an opportunity to approach their problems on a more definite and uniform basis, a better relationship could be established with the operators and agencies responsible for providing patient care,

Therefore, it is recommended that the Public Health Service undertake to establish regional meetings to train such public agency personnel, and to secure some financial aid for personnel selected to attend such training meetings.

10. Whereas nursing homes and homes for the aged have a real and vital concern with the process of aging, and

Whereas there is proposed a White House conference on aging,

Therefore, it is recommended to the U. S. Department of Health, Education, and Welfare, and to such other agencies as may participate in structuring a White House conference on aging, that the assistance of representatives of nursing homes and homes for the aged be actively sought in developing plans for the conference.

11. Whereas the thermal, acoustical, and illumination characteristics of environment have a direct bearing on the health and safety of the aged in both private and institutional homes, and

Whereas there exists today no recognized qualitative or quantitative criteria for the design of the opti-

mum environment for the aged, in terms of thermal, acoustical, and illumination factors,

Therefore, it is recommended that the Public Health Service foster the development of study and research programs leading to a better understanding of these important environmental factors and to the development of criteria which may serve as a basis for sound environmental design.

12. Whereas the proper care of the aged is a major and growing problem facing the United States today,

Therefore, it is recommended that the American Medical Association, American Hospital Association, American Nurses' Association, American Dietetic Association, American Nursing Home Association, and other groups interested in the total problem coordinate their efforts in order to bring about maximum benefits to our aging population.

Regulatory Agency Problems

1. This conference should endorse the action of the Association of State and Territorial Health Officers, November 2-8, 1957, which has formally requested the Public Health Service to collaborate with other groups having interest in the field of medical care facilities to establish classifications and definitions of such facilities.

2. The Public Health Service should be asked to develop a model law, rules, and regulations for nursing homes and homes for the aged.

3. The model law, rules, and regulations should provide that:

- each patient have his personal physician, a physician be available at all times for emergencies, and medical advice be available to the administrator;

- physical examinations be required within 48 hours of admission date and periodic examinations be made thereafter;

- the regulatory agency will specify the required records on a current basis, including identifying and socioeconomic information, records of physical examinations, and other continuing medical records.

4. The model licensure law

should include provision for an advisory committee to the regulatory agency composed of representative professional and interested groups, official and voluntary in the State concerned.

5. In drafting the model law, attention should be given to the human factors, for example, personal interest, dignity, and privacy in patient care.

6. The law, rules, and regulations should include initial and continuing evaluation of physical, mental, financial, educational, and moral qualifications of applicants for licensure to operate or manage nursing homes and homes for the aged.

7. It is recommended that in nursing homes sufficient personnel be on duty and awake at all times.

8. It is recommended that the Public Health Service undertake a study of the requirements for the staffing of nursing homes and homes for the aged.

9. It is recommended that the agency best qualified to provide the following functions should be the responsible regulatory agency: set standards for safety, environmental

health, and patient care; carry out and coordinate inspections; give consultation and planning services; and furnish teaching.

10. It is recommended that a single agency have primary regulatory responsibility for all medical care facilities and homes for the aged.

11. It is recommended that there should be provision for the exchange of information between regulatory and other agencies which would enable all concerned to carry out their responsibilities.

12. It is recommended that State regulatory agencies arrange inter-agency meetings for workers within a State.

13. It is recommended that adequate funds be made available for research and demonstration projects by State and local agencies with monies furnished by Public Health Service, the States, or other agencies.

14. It is recommended that the appropriate body or bodies should: study staffing needs, qualitatively and quantitatively, of State regulatory agencies including full-time and borrowed services; survey the resources available for education and training of personnel; and prepare a plan to supply education and training not currently offered.

15. It is recommended that the appropriate body or bodies should: study training needs, qualitatively and quantitatively, for administrators of nursing homes and homes for the aged; survey the sources available for education and training of personnel; and prepare a plan to supply education and training not currently offered.

16. It is recommended that the Public Health Service be requested to collaborate with State agencies and other interested groups to collect statistical data at least annually, regarding nursing homes and homes for the aged.

17. It is recommended that there be regional meetings similar to the National Conference on Nursing Homes and Homes for the Aged.

18. It is recommended that regional meetings be held by the

Public Health Service, working with State agency personnel giving direct service of all kinds in the area of patient care.

19. It is recommended that the Public Health Service and the State agencies prepare additional guidance materials for dissemination to

administrators of nursing homes and homes for the aged.

20. It is recommended that the Public Health Service collect pertinent material developed by State regulatory agencies and all other agencies and disseminate such information.

Financing of Facilities and Services

1. There is need for Federal legislation to further encourage financing for the construction and renovation of nursing homes and homes for the aged, including a set of recommended construction standards for use by the financing agencies when such construction or renovation meets clearly demonstrated local needs. The need for such legislation is so urgent as to require prompt consideration by the appropriate executive and legislative sections of the Federal Government.

In view of the action already taken in certain States in providing funds for housing for older people, it is recommended that consideration be given to allocation of State funds on either a grant or loan basis for the construction of homes for the aged and nursing homes.

Since county and municipal tax funds have traditionally been a primary source of financing institutions for dependent local residents, the possibility of this source for additional financing should also be considered.

2. Since realistic payments cannot be intelligently negotiated without a sound basis of cost, it is recommended that modern accepted accounting methods be adopted in nursing homes and homes for the aged.

Local agencies should be encouraged to determine costs, based on modern accepted accounting methods, related to the kinds and quality of services that can be provided. Public assistance payments should

be established to provide a minimum commensurate with these established costs.

3. It is recommended that the Public Health Service collect and publish good cost data that are presently available concerning the operation of nursing homes and homes for the aged, separated by geographic area, and further subdivided to show various levels of service.

4. It is recommended that health insurers of all types should give earnest study and consideration to the further extension of health insurance to cover care in nursing homes and other institutions performing the functions of nursing homes. The prerequisites for such action should be establishment of the medical nature of the care and specific recommendation of the service by a physician either following hospitalization or otherwise. Consideration should also be given to continuation of existing health insurance policies, regardless of age or health condition of the insured. Welfare departments should continue the payment of health insurance premiums on behalf of people who have health insurance coverage at the time they are accepted for public assistance.

5. It is recommended that States be urged to take full advantage of Federal matching funds for medical care to defray cost of care of public assistance recipients in nursing homes and related institutions providing nursing care.

Administration of Homes

1. Every nursing home and home for the aged should have an administrator who is continuously responsible for the proper operation

of the home. His functions should include planning of objectives and services; organizing staff and facilities; directing, supervising, and co-

ordinating services; reporting to the board, the public, and the clients; and budgeting.

2. All nursing homes and homes for the aged, whether nonprofit, proprietary, or public, should have a governing board or advisory committee. In some communities it may be more practical for several homes to utilize one committee.

3. Ways and means should be found for encouraging the conduct of active education programs for board and advisory committee members on their functions and responsibilities.

4. Every nursing home or home for the aged should have a medical adviser or medical advisory group. It should be the responsibility of the administrator to initiate the action for establishment of such advisory service, preferably utilizing a local general hospital. If there is no general hospital within easy access, liaison should be worked out with the medical profession through the county or State medical society.

5. A person who becomes an administrator of a nursing home or a home for the aged should be licensed to do so by a properly designated regulatory agency. Such a person should possess a personal motivation to provide or obtain suitable patient care, possess the customarily required moral qualities, and have the following minimum qualifications to merit a license:

- Graduation from an accredited high school or equivalent training.

- Successful completion of a prescribed course of training presented by a recognized educational agency. The content of the course may be planned in cooperation with pertinent professional organizations and approved by the regulatory agency. In any jurisdiction enacting legislation along this line it is expected that suitable training facilities be organized to make feasible the procurement of such training.

- A minimum of 6 months' professionally supervised experience in a recognized medical care facility

which would provide background and experience in institutional management, human relations, and ethical practices.

- For one currently functioning as an administrator of a nursing home and/or home for the aged it is further recommended that upon the establishment of a licensure program a grace period of not more than 3 years be extended as a reasonable period of time for such a person to acquire the additional training necessary to qualify for licensure. A specified number of years of appropriate experience could be accepted by the regulatory agency in lieu of this requirement.

- It is recommended that persons currently functioning as administrators of nursing homes or homes for the aged be immediately screened by a testing process designed to disqualify for such a position those who cannot demonstrate adequate ability to read and understand the regulations and literature pertinent to the operation of such institutions.

6. Every nursing home and home for the aged should have a homelike, cheerful, friendly, and hopeful atmosphere that will contribute to the promotion and preservation of the personal integrity of each individual. The home should make available and utilize those services necessary for the emotional, physical, social, and spiritual enrichment of the patient.

This would require properly trained personnel to provide: personal care including food, shelter, and personal hygiene; medical and nursing care, and rehabilitation and optimum health; social, emotional, and spiritual well-being.

Personnel should be selected on a full-time or a part-time volunteer basis to meet these needs. It is recognized that the size, location, and type of home would determine the variables in the staffing pattern of one home compared with another.

The administrator should have a knowledge of the necessary skills

and education, as well as the legal requirements for the successful performance of the services to be rendered.

In the selection and engagement of personnel, the administrator should give consideration to the individual applicant's physical, mental, and emotional qualifications for work with the resident "to help the patient to do as much as he can as well as he can as long as he can." He should try to instill in all of his staff a sense of dignity and worth as members of the team of the nursing home or home for the aged.

Personnel practices, methods, and procedures should be explained to staff members in the most effective way possible so that they will be apprised of their functions in the operation of the home. General policies under which the home operates should be written and available to all employees at all times.

7. The administrator of a nursing home and home for the aged should be responsible for determining the qualifications and suitability of each prospective employee for the job he is to perform.

8. Prospective employees should have a preplacement health examination.

9. Every administrator should provide opportunity for the growth and development of staff, professional and nonprofessional, through training either within or outside of the home. Such inservice training may be provided separately or in cooperation with each other by: nursing home associations, State welfare and health agencies, universities, professional organizations, hospitals and related institutions, and other voluntary agencies.

10. There should be uniformity of business and accounting practices in order to establish a basis for charges to patients and agencies purchasing patient care and for better planning and programing.

Smoking-Mortality Rate Among Veterans

A Public Health Service study among 198,926 United States veterans shows a significantly higher death rate among regular tobacco smokers than among nonsmokers. The first report on the continuing statistical survey was made July 8, 1958, by Dr. Harold F. Dorn, chief statistician for the National Institutes of Health, to the Seventh International Cancer Congress in London. Dr. Dorn is also chief of the Biometrics Branch in the Division of Research Services of the Institutes.

The survey generally supports findings of earlier studies which demonstrated a statistical relationship between death rates and smoking.

Death rates among the group of veterans who were United States Government Life Insurance policyholders were summarized for the period July 1954 to December 1956. The deaths were then related statistically to the smoking habits of the veterans. Clinical and laboratory research were not included in the study.

The initial report covers 7,382 deaths during the 2½-year period. Of these, 6,203 occurred in smokers and 1,179 in nonsmokers. The data was from persons who served in the Armed Forces between 1917 and 1940 and ranged in age from 30 to 90 years. The majority were between 50 and 70 years of age.

The report included the following points:

- The death rate from all causes of persons who used tobacco was 16 per 1,000, compared with 13.1 per 1,000 for persons who never smoked. Adjusted for differences in age distribution between the two groups, the death rate was 32 percent higher for smokers than for nonsmokers.
- Persons who regularly smoked only cigarettes had the highest death rate of all groups of smokers—58 percent greater than the death rate for nonsmokers.
- The lung-cancer rate for regular smokers of cigarettes only was about 10 times the death rate for nonsmokers.

- The death rate among regular cigarette smokers was closely related to the amount smoked. For example, the death rates of persons who smoked more than 40 cigarettes a day were much higher than those of persons who smoked fewer than 10 cigarettes a day.

- The death rate of persons who regularly smoked cigars or pipes, or both, was not significantly higher than that of nonsmokers. Only the heaviest users of cigar and pipe tobacco had an appreciably higher death rate from all causes than nonsmokers.

- Nearly two-thirds of the 6,203 deaths of tobacco users studied were attributed to diseases of the heart, blood vessels, and kidneys. The death rate from coronary heart disease was found to be 63 percent higher for regular cigarette-only smokers than for nonsmokers.

- Regular cigarette smokers who had stopped smoking cigarettes before the study began in 1954 had a lower mortality rate than those who continued to smoke. However, the rate was 30 percent higher than that of nonsmokers.

- Regular cigarette smokers also had higher death rates from certain respiratory diseases, such as bronchitis, pleurisy, and emphysema, from ulcers of the stomach and duodenum, and from cirrhosis of the liver.

- The death rate from coronary heart disease among regular users of cigarettes only is 63 percent higher than the rate for nonsmokers.

In addition to the use of tobacco, the continuing study will also explore possible statistical relationships between death rates and such environmental factors as occupations, work environments, and characteristics of the home communities.

Dr. Dorn's paper is entitled "Tobacco Consumption and Mortality from Cancer and Other Diseases." The study was made possible by the cooperation of the Veterans Administration.

the TRANSFORMATION of NA NGOO



INTERNATIONAL MAIL POUCH



Na Ngoo is like tens of thousands of other villages in Thailand. Its 49 families own a few pigs, a scattering of scrubby chickens, and some buffaloes. They use bamboo, palm leaves, and rice straw from the surrounding country to build their houses. Those who can afford flooring timbers raise their houses on stilts, Thai fashion, always with an odd, never an even, number of steps to confuse evil spirits. Their household possessions are essential clothing, a few pots and pans, sleeping mats of woven grasses, and large clay jars for storing a day's water supply.

Despite the historic agricultural abundance of the country, the people of Na Ngoo, like millions of other farm families in Thailand, battle poor soil, a scarcity of water 7 or 8

months of the year, and the inaccessibility of markets for their rice crops. No more than \$30 or \$40 pass through their hands in a year of back-breaking toil. They cannot afford even a dollar or two for insecticides to prevent the loss of a crop or to build a tank for storing scarce drinking water.

Na Ngoo has no public facilities. Even its water hole, a stagnant pool during the dry season, is a kilometer away. The people send their children to a school nearly 2 kilometers distant because schooling is compulsory for the first four grades, but ignore the district health center, an equal distance away.



As one of the poorest communities in a fairly prosperous district, Na Ngoo was chosen to be one of a number of village pilot projects in health and sanitation. These projects were designed to find out if even the poorest villages could be induced to change old ways and if the individualistic Thai would work with others on community projects. This was the difficult task of Alexander A. Robertson, American sanitarian, when he began work in Na Ngoo in March 1957.

Three months later, the Public Health Office of the United States Operations Mission in Bangkok got a report from Robertson that 19 sanitary privies were installed in the village and 6 more were planned for completion the next month.

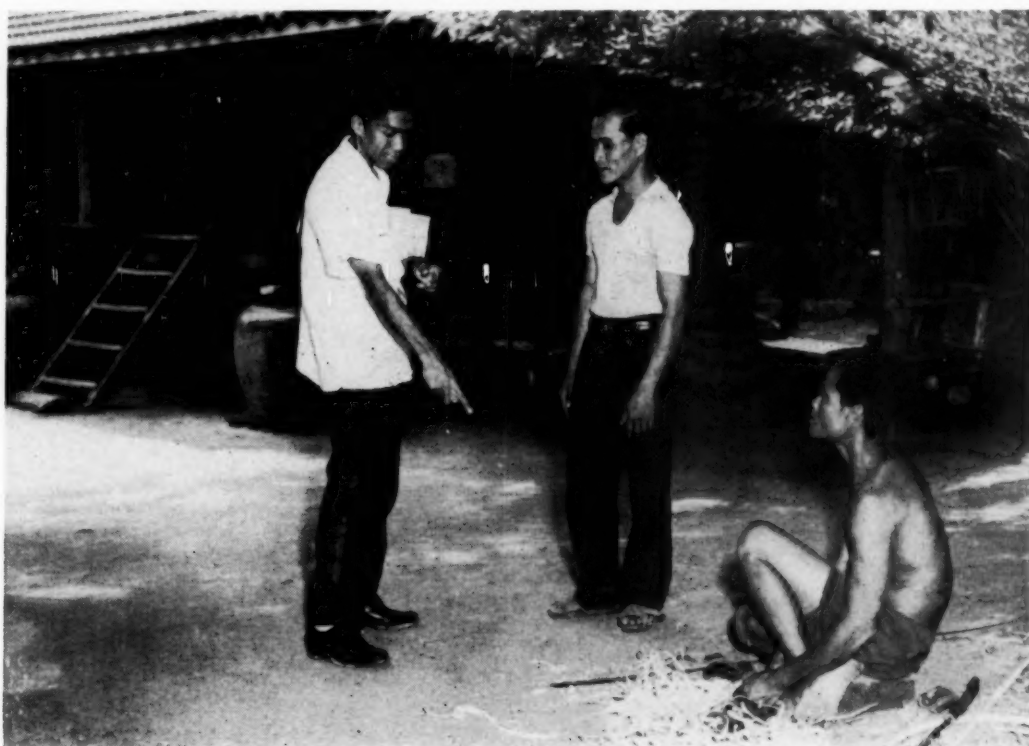
Curiosity drew us to Na Ngoo in early July. Three hours' travel from Bangkok over a fairly good, hard-surfaced road brought us to within a kilometer of Na Ngoo, but we had to make the rest of the way on foot over the rice paddy embankments. Our guides were Robertson, Dr. Khien Kraivichien, director of Choburi Health Training Center, and Nai Chit Chivonge, sanitarian instructor.

Na Ngoo's health committee meets. Headman (1st left) and school teacher (3d right) are members. Below: Wife pours rice into milling machine.





Left: Na Ngoo's privies repudiated skeptics who said they would never be accepted. *Right:* Even the pigs are well scrubbed. *Below:* Sitting villager tells sanitarian Nai Chit Chivonge (left) that the new privies saved time which he used to make baskets to sell.





Left: The old water hole, a kilometer from the village, became a stagnant pool in the dry season. *Right:* Men, women, and children dug the rain catch basin and two wells, separated from the basin by a filter system, to give the village a constant, safe supply of water.

No one expected us, and most of the people were at work in the rice fields. But when we arrived the village looked as if it had been prepared for an inspection.

We hesitated to flick a cigarette ash in the cleanswept compounds. The houses were scrubbed and orderly, with wood neatly stacked. Animal pens were as clean as living rooms and the animals themselves fairly shone; even the hogs looked as if they were ready for a State fair. Buffaloes, customarily sheltered under the stilted houses, were penned under the shade trees.

The privies were the repudiation of skeptics who said they would never be accepted because privies infringe on the Thai's historic right to relieve himself when and where he pleases. Na Ngoo had 33 of them, although 25 would have sufficed with families sharing. Not only were they clean with daily scrubbing and covered with neatly built housing of rush and bamboo, but many had been decorated with fancy grass weaving.

The pride of the villagers was also mirrored in flower and vegetable gardens, growing where none had ever existed before. Women and girls were weaving fly covers to put over food dishes. One woman, who was milling rice, told us the food value of the grain was in the bran, not the white kernel.

Close by was the village's biggest achievement, its new water supply system. Everyone,

even the children, had worked on it. The headman donated a generous piece of land. On it they built a large catch basin and dug wells on either side. Now Na Ngoo's people would not have to walk a kilometer for their water, and their water was cleaner.

Under a huge tree in the center of the largest compound the village health committee built a shelter for its meetings. Adorning the building were colorful posters proclaiming, "Prevention is better than cure."

The health committee felt it was just starting its work. After the catch basin and wells would come a corral for the village buffaloes, to keep flies and manure a safe distance from the houses. Next they planned a community compost pit, a plentiful source of organic fertilizer for the tired land.

"How did it happen?" we asked. Na Ngoo was no hothouse project. Its changes had come from the heart and muscle of the people themselves.

Our three guides and Nangsao Vimoon Thongpoonsak, health educator, and Nai Thongkam Suwarnachitr, district sanitation officer, supplied the initial spark. One evening they pushed their jeep as close as possible to the village and strung a long electric cable from the jeep's generator. They showed an entertaining motion picture and a film on sanitation. Then Dr. Khien talked to the audience, everyone in Na Ngoo, about the services the

district health center offered. He explained the advantages and problems of sanitation in the village and urged the people to talk it over. If they were interested, there would be another meeting.

A week later, the head of every family in the village gathered with Nai Chit, Nangsao Vimoon, Robertson, and Nai Thongkam. The villagers agreed that water was their big problem. The nearest supply was a kilometer away, often muddy, and at the height of the dry season, almost nonexistent. They needed more and cleaner water, and, if possible, close by. If the villagers were prepared to undertake a village sanitation program, the officials said, the health center would help them get a safe, dependable water supply and a pump.

But privies would have to come first, because the water cannot be kept clean and safe without them. And after the privies and the water supply, the village needed a general cleanup. All three steps were necessary to health, and all must be agreed to if they were to get help, the officials explained. Help would include cement and forms for making the privy slabs at cost. Payment, roughly a dollar per privy, would be required but not until after the next harvest. Any family that could not afford the cost all at once would be allowed several years to pay.

The heads of the 49 households, with some dissent, agreed to take the three steps and form a health committee.

A few days later, the men and women voted to elect the health committee members. The village was divided into 7 groups of 7 families each, and each group elected a member. The headman of the village and the local school teacher each won a place on the committee of 5 men and 2 women. If Na Ngoo had had a Buddhist temple, the abbot would have been given an honorary place on the committee, but the village is too small and too poor to support a temple.

The committee decided to start the cleanup immediately, while privy sites were selected.

They set Wan Phra, the Buddhist sabbath, as cleanup day, since it was the only day the people were not busy in their fields.

On the first cleanup day only five families worked. The second week seven more families joined them. Each week more and more people worked at the cleanup. Two families held out for almost 10 weeks, but finally they joined too. Whole families, working together, cleaned up their own compounds and then the public places. They dug the privy pits, built the housing over them, and learned to mold the slabs with the sanitarians' guidance. They built their health committee headquarters and dug the catchment and the wells.

We asked one man what part of the work was hardest. With a grin he replied, "Cleaning house," which to him meant cleaning the whole compound around his house as well. It was hardest because he did it every day after he came home, hot and tired from the fields. He didn't limit cleanup to Wan Phra.

He was eager to talk, so we questioned him. "Why is the program good for you?"

"I will make more money," he said.

"You mean save more money, don't you, by not getting sick and not having to spend money on medicines?"

"No. I will make more money. Not spend so much time looking for a place to relieve myself. Have more time to make things to sell."

Meanwhile, Nai Chit and the village committee were discussing something that seemed serious and important. The matter was finally settled with friendly smiling nods by these villagers who people said would never change their traditional easy, careless ways. On the way back to Bangkok we asked Nai Chit about it.

"The committee asked that another privy be built. A family who was sharing one with another would like to have its own. It will be built, of course."

—HARRY L. CARR and MRS. JAY S. BOHLE,
U. S. Operations Mission, Thailand

Medical Care Responsibilities

Joint letter by the Surgeon General and Commissioner of Social Security to State and Territorial Health Officers and State Directors of Public Welfare, June 26, 1958

The fields of health and welfare administration offer many opportunities for joint action which can be mutually beneficial to the responsible agencies and result in improved services to the public. These opportunities have existed for years and in some States and communities have received considerable attention. Recent developments, however, have greatly expanded the opportunities for a concerted attack on the prevention and reduction of economic dependency due to illness. These developments accentuate the need for the closest possible working relationships between health and welfare agencies at all levels of government. Anything short of this aim is costly, both in terms of taxpayers' dollars and human well-being.

This joint letter is intended to focus on the growing need and to encourage mutual consideration of program objectives, plans, and resources by State health and welfare officials.

That illness is a major contributing factor to economic dependency and that low income breeds health problems are well-known facts. Public health departments have a traditional responsibility to provide and promote communitywide health services, such as immunization, public health nursing, and casefinding programs, nutrition and health education services. Many health departments have traditional responsibilities in regard to the medically indigent which sometimes involve diagnostic and treatment services. Special arrangements to ensure the fullest possible coverage of public welfare clients in all types of health

programs should result in improved health and decreased dependency for this population group.

Provision of or payment for medical care services for public welfare clients is commonly a responsibility of public welfare agencies. Public health agencies have much to contribute to the successful operation of such services. This assistance can take the form of ensuring that welfare clients receive the direct services of the public health agency, such as services for crippled children or for tuberculosis control. In other instances, the assistance may be through professional consultation in the establishment of standards and procedures for making medical care available to the welfare client. In some States it might be desirable for the welfare department to contract with the health department to administer the medical care aspects of the public welfare program.

Obviously, the arrangements will depend upon the varying legal and operational potentialities in the States. Again, however, joint consideration of the problems is imperative to effective and efficient working relationships. This is particularly important when public welfare agencies are contemplating new or additional medical care responsibilities.

We all know that family finances and the ability and willingness of a family to seek to correct health defects are closely related. With increased emphasis on chronic disease programs and health services for older persons, the problems of economic security are becoming ever more apparent as major considerations affecting the success of public health programs.

Public welfare agencies, with their

wide experience in administering financial assistance and welfare services related to the particular needs of the individual, can be of real help to health departments in problems of this kind. The welfare department can identify health needs of recipients and assist them to fully utilize public health facilities. Similarly, provision of social services and financial assistance to persons whose need is recognized by medical social workers and other staff of the health department frequently depends upon the resources and staff of the welfare department. Such interagency relationships cannot be maintained effectively unless each agency is fully informed on the programs and resources of the other.

These examples of mutual interest areas between health and welfare agencies could be multiplied many times. The most useful identification of such areas, however, is in relation to the program objectives and resources of an individual State and as a first step in the development of interagency planning.

We are confident that increased attention to opportunities for interagency cooperation will result in better health and welfare services to the public and will enable both agencies to carry out more effectively their respective legal responsibilities.

The full resources of the Public Health Service and the Social Security Administration are prepared to provide technical assistance and consultation at your request to assist in accomplishing these goals.

L. E. BURNEY
Surgeon General

C. I. SCHOTTLAND
Commissioner of Social Security

Part two of a series, this report describes microscopic findings in bones from persons exposed to 1.0 to 4.0 ppm fluoride in comparison with a series of controls. The study discloses no pathological condition that could be attributed to fluoride ingestion.

Pathological studies in man

after prolonged ingestion of fluoride in drinking water

**E. F. GEEVER, M.D., N. C. LEONE, M.D.,
P. GEISER, M.S., and J. E. LIEBERMAN, M.A.**

PUBLIC HEALTH programs to prevent dental caries by artificial fluoridation of drinking water have always considered the possibility of cumulative toxic effects. The present studies were instituted to determine whether pathological changes could be correlated with prolonged ingestion of fluoride-bearing water.

In an earlier publication we reported the necropsy findings in persons who had lived in a community with a fluoride level of 2.5 ppm (1). This is $2\frac{1}{2}$ times the level recommended for prevention of dental caries. Since necropsies do not routinely include microscopic examination of bones, a separate study of this phase of the question was undertaken. Persons com-

ing to necropsy who had lived in communities with 1.0 to 4.0 ppm fluoride, naturally occurring or added, in the drinking water were the subjects.

Material and Method

Necropsies were performed in Grand Rapids, Mich. (1 ppm), Colorado Springs, Colo. (2.5 ppm), Amarillo, Tex. (2.8 ppm), and Lubbock, Tex. (4.0 ppm). Bone specimens were obtained through the cooperation of local pathologists: Dr. Joseph Mann and Dr. Harold Bowman of Grand Rapids, Dr. Morgan Berthrong and Dr. Raoul Urich of Colorado Springs, Dr. Marie Shaw of Lubbock, and Dr. John Denko and Dr. C. P. Churchill of Amarillo. The series consisted of 37 persons who had resided for 10 years or more in the above communities. The majority, 24, were residents of Colorado Springs; they provided 65 bones for the study. The ages of the subjects, 17 men and 20 women, ranged from 36 through 90 years.

Dr. Geever is pathology consultant, Dr. Leone is chief of medical investigations, and Miss Geiser is a nurse officer, National Institute of Dental Research, Public Health Service, Bethesda, Md. Mr. Lieberman is a mathematical statistician, Biometrics Branch, Division of Research Services, National Institutes of Health.

For comparison with the fluoride series, 33 persons, 24 men and 9 women, who had resided in essentially nonfluoride (less than 0.5 ppm) communities served as controls. They ranged in age from 21 through 87 years.

Most of the persons in both series died suddenly. The most common causes of death were trauma, coronary heart disease, and cerebral vascular accidents. Those with chronic illness and diseases known to affect bone structure were excluded. Thus, there were none with primary or metastatic bone cancer, long-standing cancer of other organs, or renal or parathyroid disease.

In most cases three bones were selected for the microscopic studies: the body of a lumbar vertebra, a portion of iliac crest, and the sixth rib. In addition, the lumbar intervertebral body joints were examined for possible changes in articular cartilage. Less often, the sternum was also studied. A few bone or joint specimens proved unsatisfactory for some phase of the study, with the result that the totals vary.

The bones were fixed in 10 percent formalin and forwarded to the National Institute of Dental Research. Decalcification was carried out using a 5-percent-formic-acid method. Paraffin embedding and sectioning were performed and hematoxylin and eosin stains were applied, according to routine procedures.

Fluoride analyses of most of the specimens in both these series (plus a few other specimens) were performed independently. The results are reported in a separate article, by Zipkin and colleagues, on pages 722-740 of this issue.

Parosteal and Marginal Tissue

Parosteal and marginal tissue consisted of laminated or loose collagenous elements often merging with and indistinguishable from periosteum. Striated muscle fibers, fat, blood vessels, lymph nodules, nerve trunks, or nerve ganglia were sometimes observed. In the sections of vertebra, the longitudinal ligaments were often included.

Focal, nonspecific, chronic inflammatory reactions were found in the marginal tissues of 4 bones from 3 persons in the control group. These foci were found adjacent to a lumbar

vertebra in 3 bones and near the sternum in 1. Focal swelling and necrosis of striated muscle fibers were found in another control, a 59-year-old woman who died of rheumatic heart disease. The changes, found near lumbar vertebra, were not accompanied by inflammatory reaction.

In the fluoride-exposed group, inflammatory change was observed in tissues of only one person. It consisted of a fairly severe subacute, nonspecific parostitis of the rib. In both the fluoride and the control groups small marrow foci were seen occasionally in periosteal and parosteal tissue of the vertebrae. These foci were undoubtedly related to the marrow of the vertebral body.

Periosteum

The periosteal surface was often irregular, microscopically, in both series. The irregularity in itself followed no consistent pattern. Sometimes slender, frayed or fuzzy papillary projections of bone and basophilic material, presumably calcium, were seen. Occasionally, smooth deposits of bone bulged up over wider areas under the periosteum. In other instances,

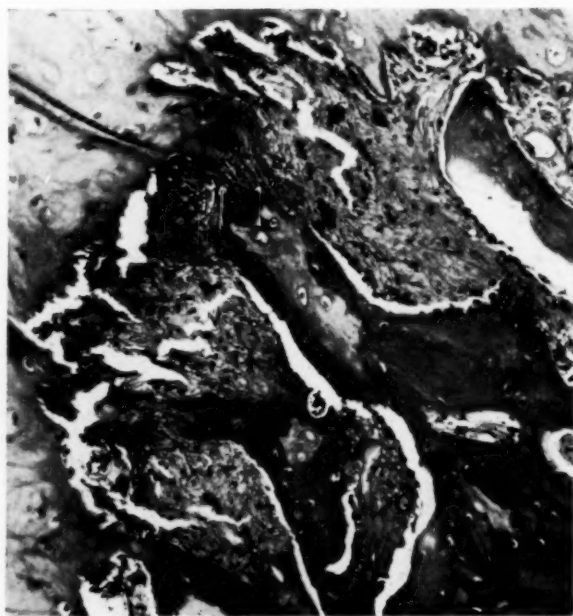


Figure 1. Active osteoclasia and fibrosis, periosteum of iliac crest, 105X, 44-year-old man, resident 40 years of a community with a natural fluoride level of 2.5 ppm.

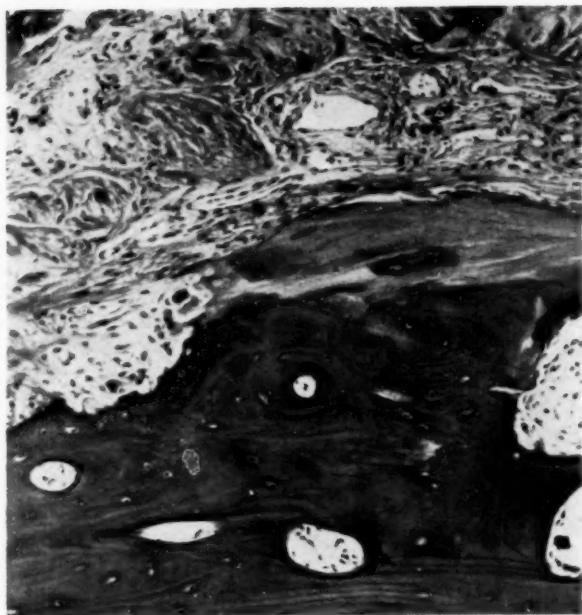


Figure 2. Active osteoclasia and fibrosis, periosteum and cortex of lumbar vertebra, 105X, 59-year-old man, control series.

new bone pushed up the periosteum in a trabecular pattern. Sometimes foci of bone were found in the parosteal tissue with no apparent connection to the subjacent bony cortex.

Irregularity in contour in some fields was due to old or active periosteal osteoclasia (figs. 1 and 2). Sometimes gaps were visible in the bone where blood vessels entered and the periosteum appeared to be the only barrier between the marrow and adjacent marginal tissue, particularly in the sections of vertebrae. The majority of the frayed or fuzzy papillary projections of bone and basophilic material appeared to be old and unaccompanied by cellular proliferation. However, small strips or foci of bright, eosinophilic, new and incompletely calcified bone (osteoid) could be observed also. Often cuboidal or columnar osteoblasts were seen nearby.

Surface irregularity was frequently found near the sites of tendon insertion in the sections of iliac crest in both groups. Often it was accompanied by cartilaginous changes and irregular basophilic staining presumably due to calcification (fig. 3). Irregularity due to extension of cartilaginous and basophilic stained material along the front periosteal surface away from the intervertebral joint and toward

the midlevel of the vertebral body was often seen.

The criteria used in grading excessive bone or calcium deposition were based on the maximum degree of projection from adjacent surfaces as measured by an ocular micrometer, the maximum foci per standard low-power microscopic field, the number of fields affected, and the presence of extraperiosteal bone or basophilic stained foci independent of the adjacent cortex. Bones from the fluoride and control groups were examined alternately.

Irregularity in periosteal contour due to excessive bone or calcium deposition, or both, was found in 48 of a total of 94 satisfactory bone sections in 25 of the 33 controls (table 1). Similar changes were present in 35 of a total of 99 satisfactory bone sections in 24 of 37 fluoride-exposed persons. Focal, nonspecific inflammation was found in 3 bones in 3 controls and in 2 bones in 2 of the fluoride group.

Active osteoclasia was found not infrequently with 1 or 2 osteoclasts recognizable in the margins of typical Howship's lacunae. Arbitrary criteria were set up to evaluate increased activity. Since the tissue sections were only approximately equal in size, quantitation could also be only approximate. Grading was started at +, for a mild, or slight, increase based on

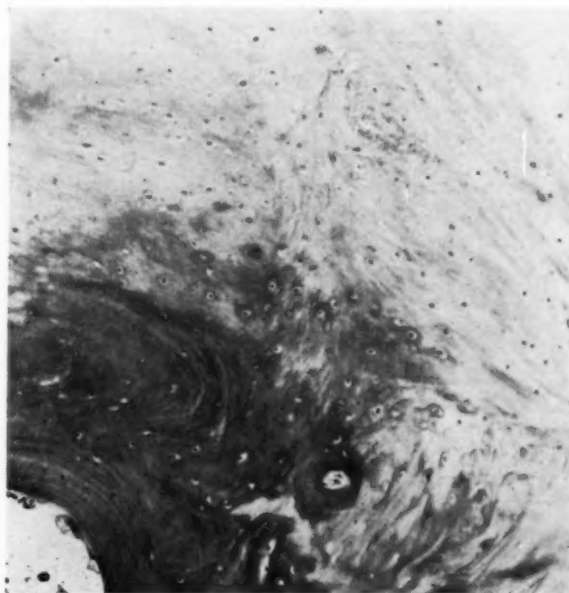


Figure 3. Parosteal and periosteal cartilaginous changes, iliac crest, 35X, 73-year-old woman, control series.

Table 1. Periosteal changes in persons ingesting fluoride and in controls

Periosteal changes	Fluoride series		Control series	
	Number bones	Number persons	Number bones	Number persons
Total examined...	99	37	94	33
Irregular periosteal bony proliferation and/or calcification	35	24	48	25
Focal periostitis	2	2	3	3
Excessive active osteoclasia	4	4	3	3

2 to 4 multinucleated osteoclasts per low-power field associated with Howship's lacunae and present in more than one field. Grade ++, or moderate, was based on at least 5 osteoclasts, and grade +++, or severe, on 7 or more osteoclasts per low-power field. On the basis of this scale, ++ osteoclasia was observed in 2 bones and + in another for a total of 3 bones with such periosteal changes in 3 controls (table 1). In the fluoride group 2 bones showed a + increase, 1 a ++, and 1 a +++ increase in activity for a total of 4 bones in 4 individuals.

Compact Cortical Bone

Recently deposited bone (osteoid) could be determined by eosinophilic staining of the matrix, as mentioned above. This was particularly impressive when layers of various ages were arranged side by side. Configuration of cement lines, degree of cellularity, and appearance and arrangement of osteoblasts and osteocytes also aided. In the compact portion, swelling of endosteal cells was sometimes observed on surfaces abutting the marrow cavity, within the Haversian canals or within large open endosteal spaces. Sometimes such cellular arrangement was also associated with strips of bright eosinophilic new bone (osteoid). Other fields showed new bone layers without evident cellular activity. Serial section in such instances might have disclosed the presence of osteoblasts nearby. Some zones revealed what appeared to be mobilization and swelling of

endosteal cells without evidence of new bone formation. This might have represented a preliminary phase in such a process.

The cortices of the rib and iliac crest were thicker than those of the vertebra, and the Haversian systems there were usually well defined. Sometimes, however, excessive decalcification made the lamellae appear delicate, poorly stained, and incompletely outlined.

An attempt was made to evaluate osteogenesis and osteoporosis objectively after the first survey of the material indicated that the differences in the amount of bone substance between the fluoride series and the controls would be slight, if there were any at all. No satisfactory method for such an evaluation could be

Table 2. Average coded measurements¹ for compact cortical bone, fluoride and control series

Bone category	Fluoride series	Control series	Both series
All bones...	1. 550 (99)	1. 734 (95)	1. 640 (194)
Lumbar vertebra along articular cartilage	1. 316 (34)	1. 418 (31)	1. 357 (65)
Lumbar vertebra cortex elsewhere	1. 510 (36)	1. 608 (31)	1. 556 (67)
Rib cortex	1. 893 (29)	2. 148 (33)	2. 029 (62)

¹ Square root of measurements.

NOTE: Figures in parentheses are numbers of measurements.

Table 3. Analysis of variance, compact cortical bone measurements

Source	d.f.	Sum of squares	Mean square	F	F .05
Mean	1	521. 95			
Total	193	45. 85			
Bone part	2	14. 59	7. 29	23. 52	3. 17
Control vs. fluoride ..	1	1. 16	1. 16	3. 74	4. 01
Sex	1	. 01			
Interactions:					
Bone part × fluoride ..	2	. 23			
Bone part × sex	2	. 77			
Sex × fluoride	1	. 02			
Within groups	57	17. 44	. 31		
Remainder	127	11. 64			

¹ Adjusted for unequal numbers.

² Significant at $P < .01$.

found in the literature, and the following approach was therefore devised:

To obtain an overall impression of representative thickness, the compact layer was measured with an ocular micrometer, and the two extremes, for the thickest and the thinnest points were recorded. All measurements were made with the same microscope, 10X ocular, and the lowest power or scanning objective, 5X N.A. 14. A rough calibration would be 1 oculomicrometer unit equals 0.1 mm. The iliac crest could not be measured satisfactorily because of marked irregularity of cortical contour. Hence only the measurements for the vertebra and the rib were used. Measurements of the cortex of the vertebral body adjacent to the hyaline articular cartilage were tabulated separately from those of the cortex of the vertebral body at other points, usually anterior and lateral. Osteoarthritic zones with spur or bridge formation were avoided as far as possible.

Statistical analysis of the measurements revealed no significant differences between the controls and the fluoride series (tables 2 and 3). The average coded measurements (square root of measurements) were 1.734 units for the controls and 1.550 for the fluoride series. The F value attributable to the difference was 3.74,

Table 4. Cortical and medullary bone changes in persons ingesting fluoride and in controls

Bone changes	Fluoride series		Control series	
	Number bones	Number persons	Number bones	Number persons
Total examined...	99	37	94	33
<i>Compact cortical bone</i>				
Architectural abnormalities.....	4	2	2	1
Excessive active osteoclasia.....	20	15	15	10
<i>Spongy medullary bone</i>				
Architectural abnormalities.....	8	5	7	5
Excessive active osteoclasia.....	18	11	11	7



Figure 4. Increased deposition of osteoid tissue, rib trabeculae, 105X, 71-year-old man, resident 48 years of a community with a natural fluoride level of 4.0 ppm.

and the theoretical F value with 1 and 57 degrees of freedom was 4.01 at the 5 percent probability level of significance.

The mean measurements for the various bone categories (the lumbar vertebral cortex adjacent to the hyaline articular cartilage, the vertebral cortex elsewhere, and the rib cortex) did, however, differ significantly (tables 2 and 3). The F value attributable to differences in the measurements was 23.52, which is to be compared with the theoretical F value of 3.17. This comparison was independent of the fluoride-control comparison, and an adjustment was made for unequal numbers of bones in the three categories.

Abnormalities in bone architecture, such as irregular or excessive new bone deposition, resorption, excessive cellularity, fibrosis, and increased active osteoclasia were evaluated also. All bones were studied for these conditions.

Focal abnormality in cortical bone architecture was found in 2 bones in 1 control (table 4). Similar focal abnormality was observed in 4 bones in 2 of the fluoride group. An example of one type of abnormality observed, focal increased osteoid deposition, is shown in figure 4.

Active osteoclasia was believed increased slightly (+) in 10 bones, moderately (++) in 3 bones, and severely (+++) in 2 bones from 10 persons in the control series of 94 bones (fig. 5). In the fluoride group of 99 bones, osteoclasia was considered increased slightly (+) in 15 bones, moderately (++) in 4 bones, and severely (+++) in 1 bone from a total of 15 individuals.

Spongy Bone of Medulla

An attempt was made, though admittedly the results are approximations only, to determine trabecular breadth or thickness by ocular micrometer measurement, as was done with the cortex. The two extremes were recorded, and a representative value was tabulated. Abnormalities in bone architecture and evidence of increased osteoclasia were recorded also.

The average coded measurements for the spongy medullary bone are given in table 5. The differences in values between the controls and the fluoride series were not significant when the figures were analyzed statistically. However, as in the cortical bone analysis, a statistical difference was found between the values for the three bone categories.

Among the controls qualitative abnormali-

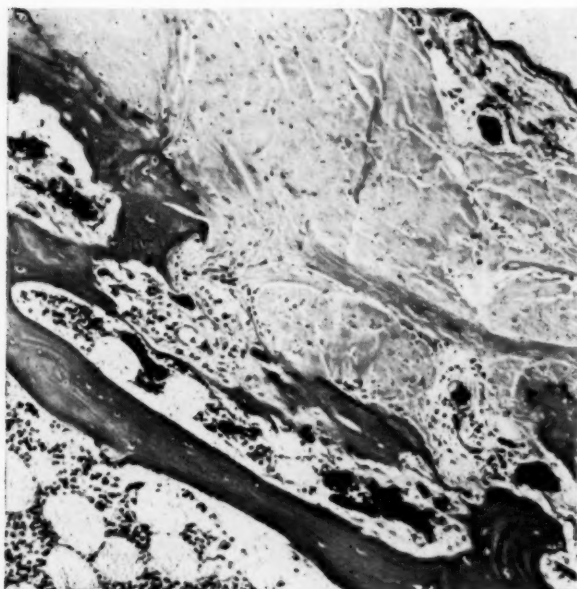


Figure 5. Increased active osteoclasia, vertebral cortex, 105X, 74-year-old man, control series.

Table 5. Average coded measurements¹ for spongy medullary bone, fluoride and control series

Bone category	Fluoride series	Control series	Both series
All parts	1. 134 (97)	1. 126 (90)	1. 130 (187)
Lumbar vertebra	1. 183 (36)	1. 185 (31)	1. 184 (67)
Iliac crest	1. 215 (32)	1. 264 (26)	1. 237 (58)
Rib . . . . .	. 984 (29)	. 961 (33)	. 976 (62)

¹ Square root of measurements.

NOTE: Figures in parentheses are numbers of measurements.

ties were found in 7 bones in 5 persons (table 4). Focal architectural irregularity was seen in 6 bones, and a small osteoma, in the seventh (fig. 6). Similar focal irregularity in architecture was observed in 8 fluoride-exposed bones in 5 individuals. No tumors were found among the fluoride group.

Active osteoclasia was believed increased slightly (+) in 11 bones from 7 persons in the control series. In the fluoride group osteoclasia was considered increased slightly (+) in 14 bones, moderately (++) in 3, and severely (+++) in 1 bone from a total of 11 persons (fig. 7). In both groups active osteoclasia was often associated with osteoblastic activity and new bone deposition nearby. Variation in staining characteristics of the intercellular substance, configuration of the cement lines, degree of cellularity, and appearance and arrangement of osteocytes and osteoblasts, as mentioned in the discussion of the cortex, combined to provide fairly reliable impressions concerning relative ages of different bone layers.

Bone Marrow

Most marrow sections of both the fluoride and the control series showed active hematopoiesis. Of 93 satisfactory marrow sections in the control group, 63 were graded +++; 25, ++; 4, +; and 1 was considered atrophic. Interesting qualitative features of the marrow sections from the controls included focal lymphoid hyperplasia (11 sections), focal erythroid hyperplasia (9 sections), and focal myeloid hyperplasia (7 sections). In 3 there was focal

proliferation of megakaryocytes. The marrow of one bone revealed rather extensive fibrosis, and that of another showed focal hyperplasia of eosinophils. There were thus 32 bones with focal qualitative marrow changes.

Of 97 satisfactory marrow sections in the fluoride-exposed group, 69 were graded +++ quantitatively; 23, ++; and 5, +. Comparative qualitative study showed 17 with focal lymphoid hyperplasia, 1 with focal erythroid hyperplasia, and 4 with focal myeloid hyperplasia for a total of 22 qualitative changes.

Intervertebral Lumbar Body Joint

Osteophytosis occurred in both groups in the form of "spurs" or "lips," sometimes bridges (figs. 8 and 9). The osteophytes were composed of irregularly arranged osteoid tissue and mature bone, irregularly calcified cartilage, and fibrous tissue often associated with increased osteoclastic activity (fig. 10). The marrow in the osteophytes was usually fatty and deficient in hematopoietic elements. Accompanying the above process were mixtures of bone, fibrous tissue, and haphazardly calcified cartilage at and near the attachment of the osteophyte to the line of junction between hyaline articular cartilage and cortical bony plate. The normally

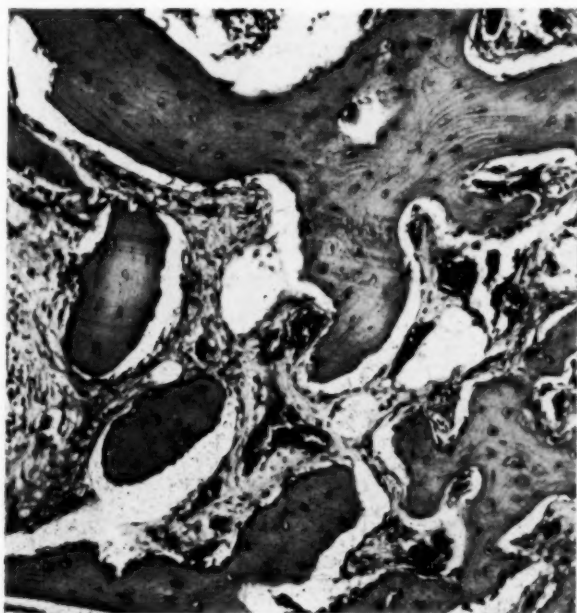


Figure 6. Small osteoma, rib medulla, 105X, 35-year-old man, control series.

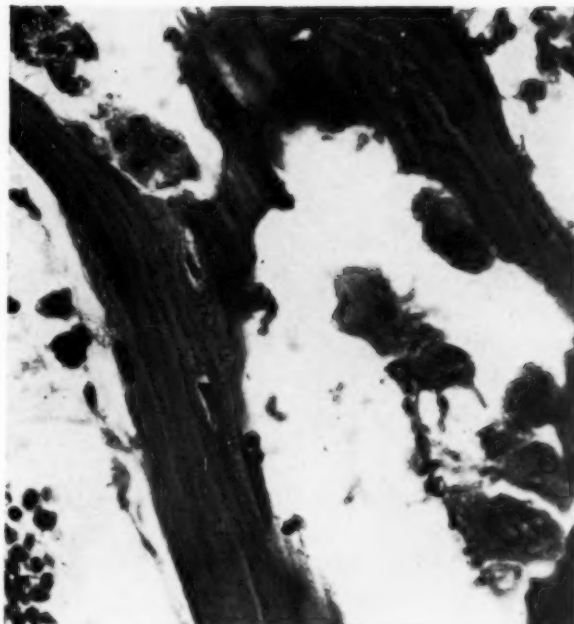


Figure 7. Increased active osteoclasia, trabecula of lumbar vertebra, 415X, 69-year-old woman, resident 28 years of a community with a natural fluoride level of 2.5 ppm.

even contour along this line was usually disrupted. Varying degrees of thickening were noted in the subchondral bone along the line of attachment to the osteophyte. Large osteophytes were often associated with irregularity in appearance of that portion of the annulus fibrosus near the attachment of the osteophyte. Fibrillation, irregularly increased porosity, or cystic degeneration was observed. Clefts in the intervertebral joint matrix were seen in both groups and were impossible to differentiate from artefacts.

The periosteum and anterior longitudinal ligaments over the osteophytic process revealed only nonspecific fibrous thickening.

No inflammatory reaction was noted within the annulus fibrosus or the nucleus pulposus even with advanced osteophytosis. The central portion of the nucleus pulposus was usually porous in the younger subjects (30-39 years) of both groups. In such cases multiple, irregularly shaped, cystic zones were apparent. They contained amorphous eosinophilic material in which occasional viable-appearing cartilage cells could be identified.

The annulus fibrosus in the young patients in

both groups consisted of fairly dense layers of sparsely cellular fibrous tissue. As this tissue approximated the nucleus pulposus, it was arranged in interlacing bands among cartilage cells.

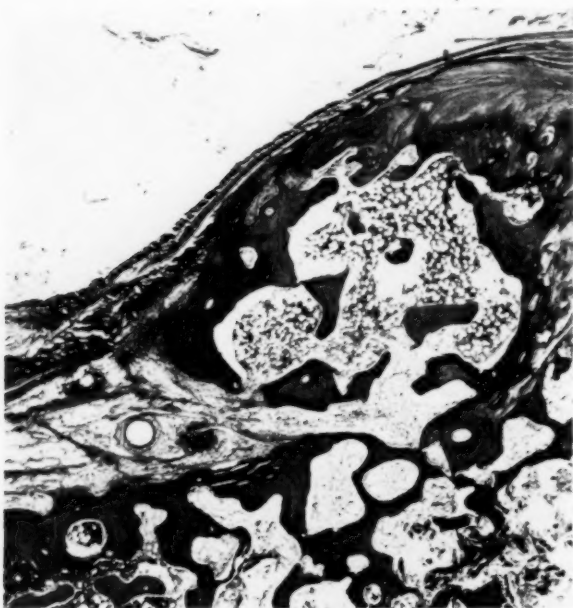


Figure 8. Osteophyte, lumbar vertebral body, 14X, 62-year-old woman, resident 19 years of a community with a natural fluoride level of 2.5 ppm.



Figure 9. Fibrosis and increased osteoclasia in an osteophyte, lumbar vertebral body, 35X, 73-year-old woman, control series.

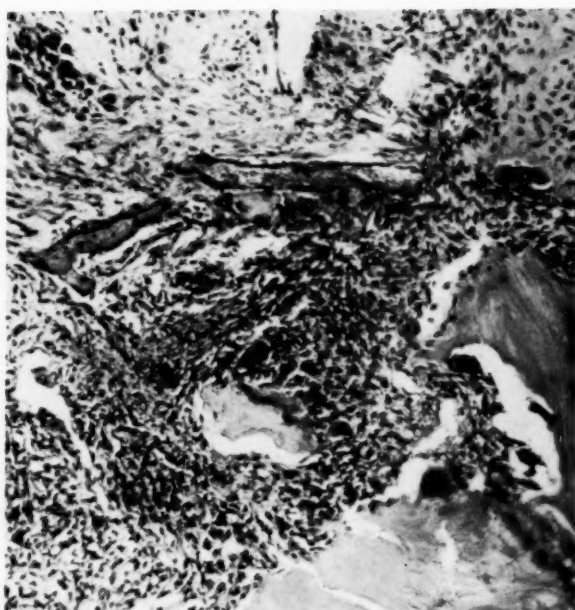


Figure 10. Increased active osteoclasia and fibrosis near osteophyte attachment, 105X, same bone and patient as in figure 9.

Also in the young patients the hyaline articular cartilage blended almost imperceptibly with the loose fibrocartilage or elastic cartilage of the nucleus pulposus and annulus fibrosus. Some variation in thickness was noted in the hyaline articular cartilage. The cartilage cells were arranged more regularly and their nuclei were oriented more nearly in parallel planes than those in the nucleus pulposus or annulus fibrosus. Occasionally, small clefts with loose connective tissue and capillaries penetrated the hyaline cartilage near its line of junction with the subchondral bone. The line of calcification was fairly even along this junction in the young patients, but prongs of cartilage extended beyond into the subchondral bone, and, similarly, microscopic prongs or tongues of bone and osteoid tissue projected upward into the hyaline articular cartilage. The marrow adjacent to the subchondral bone occasionally showed focal proliferation of delicate fibroblastic elements in the young patients of both groups.

In the aged patients of both groups cystic changes in the nucleus pulposus and fibrillar changes in the annulus fibrosus were more prominent. In the annulus near the periosteal junction, fibrosis and proliferation of vascular

Table 6. Changes in lumbar intervertebral body joints

Joint changes	Fluoride series	Control series
Total examined.....	31	35
Osteophytosis.....	12	18
Other evidence of osteoarthritis.....	4	5
Miscellaneous pathology.....	1	1

channels were sometimes observed. The vascular channels were occasionally arranged in clusters resembling telangiectasia.

Of 31 satisfactory sections of lumbar intervertebral joints from the controls, there were 12 with osteophytosis (table 6). The severity was rated arbitrarily from + to +++. In 6 persons it was graded +++, or severe. In the fluoride group of 35 satisfactory sections, there were 18 with osteophytosis. It was rated severe (+++) in 9. Other evidence of osteoarthritis included irregular proliferation of bone, osteoid tissue, cartilage, and fibrous elements disrupting the even line of junction of hyaline articular cartilage and subchondral bone. This irregularity was apart from that near the attachment of osteophytes described above. Such evidence of osteoarthritis was found in 4 controls and 5 of the fluoride group. Miscellaneous arthritic changes suggestive of trauma and accompanied by distortion of the joint were observed in one person in each series. There was no example in either series of rheumatoid spondylitis.

Discussion

Reports of microscopic bone changes in man after chronic exposure to fluorides are rare. Furthermore, some of the cases reported have been complicated by chronic disease that could have contributed to the changes. Roholm (2) reported 2 cases, 1 of which was complicated by a syphilitic infection. The other case occurred in a 68-year-old man exposed to cryolite for 25 years. The findings on gross and microscopic study included calcification of marginal tissues, ligaments, and tendons, increased thickening of the compact bone, irregular gran-

ular deposition of calcium in the intercellular substance, osteoid reaction around Haversian systems, and deposition of calcified fibrous tissue. The fluoride level of the bones was as high as 60 times normal values.

Another case, reported by Linsman and McMurray (3) and later listed in the Atlas of Orthopedic Pathology (4), was complicated by chronic renal disease. This occurred in a 22-year-old white man from a high-fluoride area in Texas. On microscopic examination his bones were described as having large trabeculae and "granular" architecture with lamellae which were irregular, not well seen, and with a tendency to fragmentation. Also described was some "condensation" of bone at the periphery of the trabeculae. The sternum contained 0.69 percent fluoride and the lumbar vertebra 0.75 percent.

In 1937 Bauer, Bishop, and Wolff (5) presented the findings in a worker exposed to phosphate rock containing about 4 percent fluoride. At necropsy the chemical concentration of the bones was 10 to 20 times normal fluoride values. The microscopic changes, reported only in a rib, included an increase in width of the cortex and thickening of the trabeculae. These investigators found no young osteoid tissue and no widespread deposits of calcium as described by Roholm. They observed little distortion of the normal bone architecture except reduction in the diameter of the Haversian canals and encroachment upon the marrow.

Weinmann and Sicher (6) advanced a tentative theory of the effects of fluorides in older persons and animals: first, there is a slow and incomplete destruction of compact bone and partial transformation into spongy bone; then, fairly dense osteophytes of both immature and mature bone and narrow osteoid seams are laid down as compensatory reinforcement, most prominent near the periosteum.

In our study microscopic changes in ligaments, parosteal tissue, and the periosteum were more numerous in the controls than in the fluoride series. Nothing comparable to Roholm's findings of calcification of marginal tissues, ligaments, and tendon was observed. Focal calcification and cartilaginous changes of the periosteum and adjacent tendon or fascia of the iliac crest were seen with equal frequency

and intensity in both the control and the fluoride groups and were interpreted as normal.

Statistical analysis of measurements of bone mass in the cortex and medulla revealed no significant difference between the controls and the fluoride series. Since the fluoride group was approximately 12 years older than the control group (table 7), the differences in occurrence of osteoclasia and osteophytosis were studied further to determine whether there was any relation to age.

Table 7. Average age (in years) of persons supplying bone and joint specimens for microscopic examination

Sex	Fluoride series	Control series	Both series
Both sexes	67.8 (37)	55.6 (33)	62.0 (70)
Male	64.5 (17)	54.0 (24)	57.3 (41)
Female	70.5 (20)	60.0 (9)	67.2 (29)

NOTE: Figures in parentheses are numbers of persons.

Ten of the 15 bones with increased active osteoclasia in the cortex of the controls were from 6 persons 60 years of age or over. There were 41 bones from 14 subjects in this age category; thus the incidence of increased osteoclasia, by bones, was 24.4 percent. By contrast 16 of the 20 bones with increased cortical osteoclasia in the fluoride series were from 16 persons 60 years of age or over. There were 68 bones from a total of 26 subjects in this age category for an incidence, by bones, of 23.5 percent.

Increased active osteoclasia in the medulla was similarly considered. Eight of the 11 bones of the controls with that finding were from 5 persons 60 years of age or over. Thus, the incidence for the 41 bones from this age category was 19.5 percent. In the fluoride series 17 of the 18 bones with that finding were from 10 persons aged 60 or over. The 68 bones from that age group yielded an incidence of 25.0 percent.

Examination of lumbar intervertebral body joints showed an increase in osteophytosis in the fluoride series. Many roentgenologists and orthopedists feel that osteophytosis in the lum-

bar vertebrae is not in itself to be considered a manifestation of arthritis or a cause for symptoms or disability (7, 8). Schmörl (9) found spinal osteophytes in 90 percent of all women over 60 years of age. On analyzing our data in the light of the difference in average age between the two groups, the difference in incidence of osteophytosis almost disappears. Nine of 13 patients, 69.2 percent, 60 years of age or over among the controls had osteophytosis as compared with 16 of 24, 66.0 percent, in the same age category in the fluoride series.

The differences in incidence of architectural abnormalities were not significant. Bone marrow examinations showed focal qualitative changes of minor importance. They were more frequent in the controls than in the fluoride series.

The results of this study can be correlated to some extent with previous work on necropsy material in Colorado Springs, where the fluoride level is 2.5 ppm (1). In that study there was no significant difference in the occurrence of bone cancer between 334 long-term residents (more than 20 years) and 188 short-term residents (less than 5 years). There were 3 deaths attributed to bone cancer in the former group and 2 in the latter. The microscopic study of bones adds further support to the belief that fluoride in drinking water at a level of 1.0 ppm can be ingested without cumulative toxic effect.

Summary

Microscopic examinations were made of 99 bones from 37 persons coming to necropsy who had resided 10 years or more in communities where the drinking water contained 1 to 4 ppm of naturally occurring or artificially added fluoride. Ninety-four bone specimens from 33 controls who had lived in areas where the drinking water contained less than 0.5 ppm fluoride were used for comparison.

In addition to the bone specimens, the lumbar intervertebral body joints of the subjects were examined.

The microscopic examinations showed no significant differences between the fluoride-exposed group and the control group that could be related to fluoride intake. Microscopic changes

in the bones and joints incidental to aging and due to non-fluoride-related conditions were observed in both series.

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Radiation Protection

The New Jersey Legislature has created a Commission on Radiation Protection in the State department of health. The recently approved Radiation Protection Act specifically details the duties and responsibilities of the health department and the newly created commission.

The commission, consisting of five scientifically trained members appointed by the Governor and serving 4-year terms without compensation, will adopt, promulgate, amend, and repeal codes, rules, and regulations that may be necessary to prohibit or prevent unnecessary radiation.

Policies and programs developed by the health department under authority of this act will be reviewed by the commission. The commission, when requested, will also provide the department with technical advice and assistance.

The health department's responsibilities with regard to radiation protection will encompass administration, personnel, program development and evaluation, consultation with interested or affected groups, research, training, and demonstrations, health education and

information, review of plans and specifications for the design and shielding of radiation sources, and inspection.

The act requires "all sources of radiation shall be shielded, transported, handled, used, and kept in such manner as to prevent all users thereof and all persons within effective range thereof from being exposed to unnecessary radiation." The health department is empowered to issue orders directing persons to cease and abate causing, allowing, or permitting "unnecessary radiation." In the event of an emergency, the health department has the right to order immediate compliance with codes, rules, and regulations laid down by the commission, and it may bring civil action in the Superior Court to prevent violations of the provisions.

No ordinance, resolution, or regulation concerning unnecessary radiation adopted by any municipality, county, or local board of health can be effective, according to the act, until a certified copy of such ordinance or regulation has been submitted to the commission and approved by the commissioner of the health department.

Analysis of the rib, iliac crest, vertebra, and sternum for fluoride indicates a direct increase in bone fluoride with an increase in fluoride in drinking water up to 4.0 ppm.

Fluoride deposition in human bones

after prolonged ingestion of fluoride in drinking water

I. ZIPKIN, Ph.D., F. J. McCLURE, Ph.D., N. C. LEONE, M.D., and W. A. LEE, B.S.

IN CONJUNCTION with microscopic examination of human bones for possible effects of prolonged ingestion of fluoride in drinking water (reported in this issue by Geever and associates, pp. 721-731), essentially the same bones were analyzed for ash and fluoride. These bones were obtained at autopsy from 69 persons, 36 of whom were exposed to 1.0 to 4.0 ppm fluoride for 10 to 76 years. The remaining 33 had lived in areas with less than 1.0 ppm fluoride for 10 to 87 years.

This study represents the first systematic survey of the fluoride concentration of bones of individuals exposed to various concentrations of fluoride in drinking water. Previous studies of exposure to high levels of fluoride, recently reviewed by McClure and associates (pp. 741-746 of this issue), have dealt with no more than

four cases (1-5). More extensive data have been reported on the fluoride concentration of selected bones of individuals in low-fluoride areas (6-8).

Most of the persons whose bones were examined in the present studies died suddenly, the chief causes being trauma, coronary heart disease, and cerebrovascular accidents. Although bones of persons with chronic illness or diseases known to affect bone structure were excluded from the microscopic study, they were included in the fluoride deposition study so that the effect of such conditions might be observed. The fluoride analysis thus included bones from 3 individuals with a malignancy and 3 with renal disease.

The 69 individuals in the fluoride deposition study, 40 men and 29 women aged 26 through 90 years, provided 190 bones and 64 specimens of intervertebral cartilage. Approximately 80 percent of these bones and cartilage specimens were also examined histologically. The bones, consisting of a portion of the iliac crest, the lumbar vertebra, and the sixth rib, were fixed in 10 percent formalin at autopsy.

Dr. Zipkin and Dr. McClure, biochemists, are respectively assistant chief and chief of the Laboratory of Biochemistry, National Institute of Dental Research, Public Health Service. Dr. Leone is chief of medical investigations with the institute, and Mr. Lee is a chemist with the biochemistry laboratory.

Table 1. Percentage ash and fluoride in dry, fat-free bones of individuals ingesting drinking water containing less than 1 ppm fluoride

Subject No.	Sex	Age (years)	Residence (years)	Iliac crest		Rib		Vertebra	
				Ash	Fluoride	Ash	Fluoride	Ash	Fluoride
0.1 ppm fluoride									
1	Male	27	27	56.8	0.019	61.4	0.020	50.2	0.031
2	Male	32	12	56.2	.044	56.9	.037	50.4	.054
3	Male	35	35	58.1	.045	59.4	.043	43.7	.043
4	Female	38	12					52.2	.024
5	Male	47	10					49.9	.056
6	Female	47	15	57.6	.020	57.9	.024	46.6	.019
7	Male	50	25	59.6	.030	60.9	.024	51.7	.026
8	Female	55	20	58.9	.038	53.9	.043	43.8	.036
9	Male	56	20	52.6	.046	57.8	.047	47.9	.057
10	Male	62	62	54.9	.032	57.6	.028	50.9	.038
11	Male	62	62	58.8	.024	57.3	.031	46.8	.028
12	Male	65	41	54.2	.034	54.0	.062	43.2	.034
13	Male	66	15	57.6	.028	61.9	.039	45.7	.026
14	Female	68	10	62.9	.073	65.5	.077	55.7	.079
15	Male	69	10	58.3	.035	60.0	.037	50.5	.034
16	Male	70	60	54.8	.032	60.2	.039	44.3	.042
17	Female	73	32	54.0	.048	57.6	.060	44.6	.055
18	Female	82	40	56.8	.044	58.8	.037		
19	Male	87	87	59.2	.055	59.8	.062	46.9	.059
0.2 ppm fluoride									
20	Female	32	10			68.4	0.023	53.6	0.038
21	Male	32	32	58.8	0.053	64.1	.031	51.7	.043
0.3 ppm fluoride ²									
22	Female	48	48			60.5	0.048		
23	Male	53	24	59.7	0.046	54.4	.056	47.3	0.050
24	Male	59	57					46.2	.093
25	Female	74	25	59.0	.078	57.9	.089	43.7	.077
0.1-0.4 ppm fluoride									
26	Male	32	32			56.2	0.062	45.4	0.061
27	Female	40	10			60.6	.071	49.8	.111
28	Male	44	10			53.4	.039	46.4	.042
29	Male	57	34			60.2	.039	44.9	.040
30	Male	59	10			54.4	.078	48.5	.094
31	Male	64	10			60.4	.064	51.4	.075
32	Male	71	10			60.0	.069	45.3	.083
33	Male	74	20			51.3	.106	49.8	.119
Mean		55.5	28.1	57.4	.041	58.8	.050	49.0	.054
SE		2.8	3.4	.3	.003	.7	.004	.6	.005

¹ Resident of Baltimore, Md.; water fluoridated to 1 ppm in November 1952; received fluoridated water for 2 years.

² Residents of Washington, D. C.; water fluoridated to 1 ppm in June 1952; received fluoridated water 4, 2, 3, and 3 years, respectively.

The intervertebral cartilage was separated from the vertebra, and all specimens were cleaned of adhering soft tissues. Each sample was dried overnight at 105° C., broken into pieces, and extracted with alcohol for 8 hours and with ether for 4 hours. After the sample was ground to pass a 60-mesh sieve, a portion was ashed for 3 hours at 550° C. and analyzed for fluoride (9-11). The significance of the differences in means was calculated according to Fisher's *t* test for paired values. The sodium, potassium, calcium, magnesium, phosphorus, carbon dioxide, and citrate contents of these tissues will be reported later.

Bone Fluoride

The percentages of ash and fluoride in dry, fat-free bones for each individual in the study, grouped according to the level of fluoride in the drinking water, are recorded in tables 1 through 4. Ages and years of residence are also given, but it is not possible to detect any definite relation between the fluoride concentration and these factors.

The fluoride values for the 15 bones from the individuals who had a malignancy or renal disease were within the variations encountered for others in the same group (subject No. 5 in table 1; subjects Nos. 8, 10, and 11 in table 3; iliac crest, subject No. 1 in table 4) or slightly higher (subject No. 2 in table 2; rib and vertebra, subject No. 1 in table 4). No significance can be attached to the somewhat higher values since they occurred in individuals from the two

smaller groups (tables 2 and 4). Moreover, approximately a tenfold increase in fluoride concentration of the bones from the lowest to the highest fluoride areas (tables 1 and 4) was seen without any apparent tissue damage.

Less Than 1 ppm Fluoride

Individuals exposed to less than 1 ppm fluoride were residents of several localities, with fluoride concentrations in the drinking water varying from 0.1 ppm in New York City to 0.4 ppm in San Antonio, Tex. The mean was 0.2 ppm. Five persons in this group, aged 32 through 74 years, drank water fluoridated to 1 ppm fluoride for 2 to 4 years. The fluoride content of the bones of these five was within the variations encountered in other samples in this group (table 1).

On a dry, fat-free basis, the mean concentrations of fluoride in the various bones of individuals exposed to less than 1 ppm fluoride were similar, 0.041, 0.050, and 0.054 percent for the iliac crest, the rib, and the vertebra, respectively. As expected, the fluoride concentrations of the rib and the vertebra were generally highest in the individuals from San Antonio.

Five samples of sternum from this group varied from 0.040 to 0.101 percent fluoride with a mean, \pm standard error, of 0.066 ± 0.012 percent (not including one inordinately high value of 0.229 percent fluoride). On an ash basis, they ranged from 0.078 to 0.188 with a mean of 0.134 percent. The mean concentration of fluoride in the ash of the vertebra (0.112 ± 0.010

Table 2. Percentage ash and fluoride in dry, fat-free bones of individuals ingesting drinking water containing 1 ppm fluoride, Grand Rapids, Mich.¹

Subject No.	Sex	Age (years)	Residence (years)	Iliac crest		Rib		Vertebra	
				Ash	Fluoride	Ash	Fluoride	Ash	Fluoride
1	Female	64	12			57.8	0.135	45.9	0.130
2	Female	64	15	61.9	0.176	59.7	.195	48.4	.238
3	Male	82	10	59.5	.137	54.5	.119	51.3	.140
4	Female	83	20	61.1	.137			53.3	.135
5	Male	85	50	62.2	.100	57.4	.106	50.9	.159
	Mean	75.6	21.5	61.2	.138	57.4	.139	50.0	.160
	SE	1.5	7.4	.6	.016	1.1	.020	1.3	.020

¹ Fluoride added to drinking water January 1945. Subjects received fluoridated water for 12 years with exception of male aged 82 years.

percent) was similar to that of the sternum ash (0.134 ± 0.023 percent), but it was significantly higher than that in the ash of the iliac crest (0.072 ± 0.006 percent, $P < 0.01$) or in the rib (0.086 ± 0.008 percent, $P < 0.05$).

While ash concentrations of the vertebra and the sternum were similar (49.0 percent and 49.4 percent), they were significantly lower than that of the iliac crest (57.4 percent, $P < 0.01$) or the rib (58.8 percent, $P < 0.01$).

Fluoride Level of 1 ppm

A second group, composed of 5 persons, were residents of Grand Rapids, Mich., where the water supply was fluoridated to 1 ppm in January 1945. The autopsy specimens were obtained between November 1956 and January 1957; thus exposure to 1 ppm fluoride was for a maximum of 12 years during the last years of life.

As with the low-fluoride group, no differences were found in the concentration of fluo-

ride in the various bones of this group (table 2). On a dry, fat-free basis, the mean percentages were 0.138 for the iliac crest, 0.139 for the rib, and 0.160 for the vertebra. The fluoride concentrations of the ash of the iliac crest (0.225 ± 0.026 percent) and of the rib (0.241 ± 0.030 percent) were similar, but they were significantly lower than that of the vertebra (0.323 ± 0.043 percent, $P < 0.05$). Appreciable amounts of fluoride thus accrued during the last 10 to 12 years of life of these 5 individuals aged 64 through 85 years.

For the 5 exposed to 1 ppm fluoride, the concentrations of ash in the iliac crest (61.2 percent) and the rib (57.4 percent) were similar but significantly higher than that of the vertebra (50.0 percent, $P < 0.01$).

Fluoride Level of 2.6 ppm

Colorado Springs, Colo., and Amarillo, Tex., were the residences of 27 subjects. Colorado Springs has had a uniform and verified history

Table 3. Percentage ash and fluoride in dry, fat-free bones of individuals ingesting drinking water containing a mean of 2.6 ppm fluoride, Colorado Springs, Colo., and Amarillo, Tex.

Subject No.	Sex	Age (years)	Residence (years)	Iliac crest		Rib		Vertebra	
				Ash	Fluoride	Ash	Fluoride	Ash	Fluoride
1	Male	36	10	59.6	0.095	57.8	0.106	47.3	0.098
2	Male	36	36	58.9	.092	61.1	.103	49.7	.145
3	Female	47	10	57.3	.219	59.7	.194	54.3	.239
4	Female	47	15	61.4	.481	66.7	.370	56.8	.521
5	Male	50	10	57.9	.129	58.3	.199	52.7	.179
6	Female	53	22	61.2	.111	62.2	.134	52.4	.163
7	Female	54	20	62.0	.247	65.0	.179	53.8	.332
8	Male	54	20			56.1	.269	43.7	.325
9	Male	56	10	57.3	.141	55.1	.104	44.9	.150
10	Male	57	46	58.2	.288	59.5	.278	32.7	.197
11	Male	58	25			58.9	.391	45.0	.334
12	Female	63	25	60.0	.297	58.0	.279	47.8	.305
13	Male	65	30	60.0	.268	56.9	.276	47.9	.299
14	Female	66	10	62.7	.214	59.4	.194	44.3	.244
15	Female	69	28	59.9	.458	58.2	.453	50.7	.548
16	Male	71	36	53.3	.454	57.2	.363	47.2	.400
17	Female	75	16	60.8	.237	59.3	.244	42.6	.262
18	Male	76	76	61.6	.371	55.5	.347	54.0	.346
19	Male	79	40	61.7	.176	59.4	.161	47.3	.189
20	Female	80	13	60.4	.190	59.5	.205	50.2	.293
21	Female	81	52	60.1	.321	59.3	.293	36.6	.264
22	Female	82	76	56.4	.334	52.3	.338	46.0	.382
23	Female	83	54	62.0	.325	62.4	.267	51.9	.367
24	Female	83	60	58.6	.348	62.4	.373	56.1	.363
25	Male	84	32	60.9	.154	58.6	.121	53.7	.177
26	Female	84	62	59.3	.431	61.7	.443	45.4	.321
27	Male	90	55	60.9	.304	62.2	.245	48.1	.295
Mean		65.9	32.9	59.7	.267	59.7	.257	48.3	.286
SE		3.0	4.0	.4	.023	.6	.020	1.1	.023

Table 4. Percentage ash and fluoride in dry, fat-free bones of individuals ingesting drinking water containing a mean of 4.0 ppm fluoride, Lubbock, Tex.

Subject No.	Sex	Age (years)	Residence (years)	Iliac crest		Rib		Vertebra	
				Ash	Fluoride	Ash	Fluoride	Ash	Fluoride
1	Male	26	17	58.6	0.445	62.8	0.458	51.2	0.564
2	Male	53	10	60.8	.374	54.5	.401	47.5	.348
3	Male	71	48	62.1	.542	53.3	.449	59.9	.470
4	Female	74	10	58.1	.291	59.4	.284	44.3	.261
	Mean	56	21.3	59.9	.413	57.5	.398	50.7	.411
	SE	11	9.1	.9	.053	2.2	.040	3.4	.068

of 2.5 ppm fluoride within narrow limits for some 75 years (12, 13). The fluoride level of the water of Amarillo from 1934 to 1948 ranged from 3.6 ppm to 6.2 ppm (14). According to a personal communication from the city chemist, 33 new wells were added between 1948 and 1953, and the fluoride level ranged from 2.6 to 3.2 ppm. In 1955 and 1956 the water supply of Carson County, which probably contains less than 1 ppm fluoride inasmuch as Dean (15) considered the incidence of mottled enamel virtually negative, was developed to augment that of Amarillo. In 1957, 92 wells were pumping into the Amarillo reservoir, and the fluoride content averaged 1.6 ppm. From 1948 to 1957, the fluoride level of the drinking water in Amarillo averaged 2.8 ppm, and the weighted mean for the two cities was 2.6 ppm.

For the 27 individuals, the mean fluoride concentration, on a dry, fat-free basis, of the iliac crest was 0.267 percent; of the rib, 0.257 percent; and of the vertebra, 0.286 percent (table 3). On an ash basis, the mean concentration of fluoride in the vertebra (0.598 ± 0.015 percent) was significantly higher than that in the iliac crest (0.450 ± 0.040 percent, $P < 0.01$) or in the rib (0.432 ± 0.036 percent, $P < 0.01$). The concentration of ash in the iliac crest and the rib (59.7 percent) was significantly higher than that in the vertebra (48.3 percent, $P < 0.01$).

Fluoride Level of 4.0 ppm

Prolonged exposure to about 4.0 ppm fluoride in the drinking water took place in Lubbock, Tex., now the largest community in the United States reported to have this much fluoride. Because of the unusually high fluoride content of

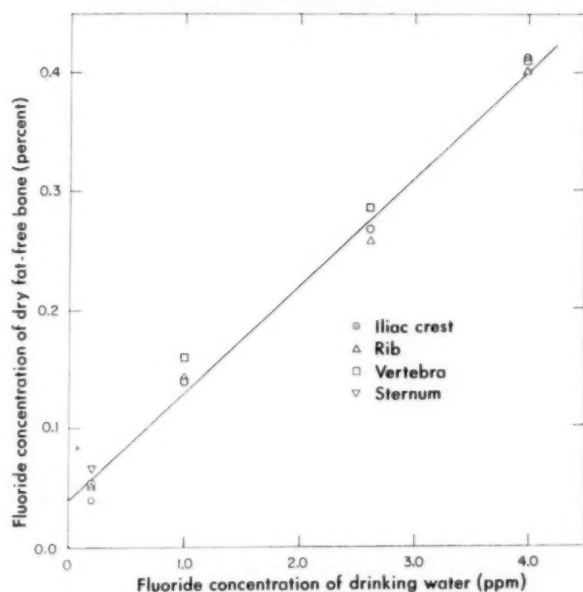
its drinking water, Lubbock, as well as Amarillo, has been the scene of a number of previous studies of the effects of fluoride (14-18). The water fluoride of Lubbock up to 1948 ranged from 3.5 to 4.4 ppm (14). In a recent letter from the Lubbock City-County Health Department, the fluoride content of the water supply from storage reservoirs was reported to have varied from 3.1 to 5.2 ppm from 1948 through 1955, with a mean of 4.0 ppm. The four subjects from Lubbock were autopsied from May through July 1955.

For the Lubbock residents as for the other subjects, the fluoride concentrations of the dry, fat-free iliac crest, rib, and vertebra were not significantly different, being 0.413, 0.398, and 0.411 percent, respectively. Although the concentration of fluoride in the ash of the vertebra (0.802 ± 0.109 percent) was greater than that of the iliac crest (0.687 ± 0.081 percent) or that of the rib (0.629 ± 0.095 percent), the difference was not significant ($P > 0.05$). The ash content of the iliac crest (59.9 percent) and that of the rib (57.5 percent) were similar but higher than the ash content of the vertebra (50.7 percent). An unusually high value of 59.9 percent ash for a specimen of vertebra prevented any level of significance being attached to the difference in the mean ash content of the various bones.

Group Comparison

To summarize these data, the mean concentrations of fluoride in the various bones were plotted against the fluoride level of the drinking water to which the individuals were exposed (see chart). The result indicates that the relation between fluoride in the bones and fluoride

Relation of fluoride in dry, fat-free bones to fluoride in drinking water.



in the drinking water up to 4.0 ppm is adequately described by a straight line function.

Other Findings

The concentration of fluoride in the dry, fat-free intervertebral cartilage also appeared to increase somewhat with elevated levels of water-borne fluoride (table 5). Calcification of this tissue, however, appears not to have been affected by the fluoride concentration of the drinking water.

In addition to the fluoride and ash analyses reported in the preceding tables, it may be of interest to note that the fat content of neither the bones nor the intervertebral cartilage was

related to the fluoride content of the drinking water. The mean concentrations of fat in the oven-dry bones had the following range:

	Fat content (percent)	
	Lowest	Highest
Iliac crest.....	23. 2±5. 7	35. 3±2. 6
Rib.....	23. 4±3. 6	30. 2±5. 7
Vertebra.....	32. 2±7. 6	43. 8±4. 3
Sternum ¹	41. 3±4. 3	41. 3±4. 3
Intervertebral cartilage...	1. 8±. 2	3. 3±. 8

¹ Only one fluoride group examined.

Discussion

The fluoride concentrations in the bones examined in the present study from both low-fluoride areas and high-fluoride areas approximate those observed in the previous limited studies (tables 6 and 7). For one resident of London, a low-fluoride area, a very high value of 0.687 percent fluoride in rib ash was obtained (7). The highest concentration of fluoride found in the present study in bones of individuals who had been drinking water containing less than 1.0 ppm fluoride was 0.428 percent in a sample of ashed sternum, and the next high value was 0.238 percent fluoride for a sample of vertebral ash. In considering the data for high-fluoride areas, some reservations must be attached to the high values presented by Kilborn and associates (5), since these results may have been due to the subnormal living standards and the low nutritional status of this area (Chengtzu, China).

Fluoride in the drinking water up to 4.0 ppm did not affect the ash content of any of the bones analyzed.

For any given level of fluoride in the drinking water, the mean concentrations of fluoride in the

Table 5. Percentage ash and fluoride in intervertebral cartilage in relation to fluoride level of drinking water

Fluoride level of water (ppm)	Number of samples	Dry, fat-free basis		Ash basis
		Ash	Fluoride	Fluoride
<1.0.....	29	4. 8±0. 3	0. 003±0. 000	0. 049±0. 008
1.0.....	5	3. 9±. 3	. 004±. 001	. 090±. 029
2.6.....	26	3. 8±. 2	. 004±. 001	. 098±. 015
4.0.....	4	4. 2±. 1	. 007±. 003	. 159±. 056

NOTE: Data are expressed as mean ± standard error.

Table 6. Percentage fluoride in human bone ash from low-fluoride areas

Fluoride level of water (ppm)	Bone	Number of samples	Fluoride in bone ash (percent)	Source of data
0.0	Rib	1	0.01	Boissevain and Drea (3).
	Humerus	1	.1	Do.
	Tibia	1	.02	Do.
	"Toe"	1	.16	Do.
Not given, presumably low. ¹	Skull	1	.059	Klement (19).
	"Long bones"	(2)	.070	Do.
	Rib	11	0.048-.21	Roholm (1).
	Iliac crest	13	³ .028-.128	Martin (8).
0.1	Rib	83	.006-.252	Smith and associates (7).
	Vertebra	83	.005-.331	Do.
0.0-0.5	Rib	25	.115-.687	Glock and associates (6).
	Iliac crest	20	.034-.132	Present study.
1.0	Rib	30	.033-.207	Do.
	Vertebra	31	.040-.238	Do.
	Sternum	5	.078-.188	Do.

¹ Designated as "normal" individuals.

² Not given.

³ Data originally given on dry, fat-free basis; calculated to ash basis assuming mean ash value of 59.0 percent for iliac crest from present study.

Table 7. Percentage fluoride in human bone ash from high-fluoride areas

Fluoride level of water (ppm)	Bone	Number of samples	Fluoride in bone ash (percent)	Source of data
2.0	Rib	4	0.12-0.35	Boissevain and Drea (3)
5.9 and 6.3	Miscellaneous	15	1.47-2.21	Kilborn and associates (5)
	Sternum	1	.69	Linsman and McMurray (4).
4.4-12.0	Vertebra	1	.75	Do.
8.0	Miscellaneous	8	.715-.967	McClure and associates. ¹
	Iliac crest	33	.157-.872	Present study.
1.0-4.0	Rib	35	.150-.843	Do.
	Vertebra	36	.208-1.103	Do.

¹ This issue of *Public Health Reports*, pp. 741-746.

dry, fat-free iliac crest, rib, and vertebra were similar. On an ash basis, however, the fluoride concentration of the vertebra was significantly higher than that of the rib at fluoride levels up to 2.6 ppm. At higher amounts of fluoride in the drinking water, this difference did not obtain.

Previous studies dealing with fluoride deposition in the white rat (20-22) and urinary fluoride excretion by the rat (23) and by man (24, 25) have indicated that as bone ages it may lose some of its capacity to store fluoride. This decrease in fluoride deposition with increasing age has been presented in graphic form by Hodge (26) based on the data on man of Smith and associates (7). In the present study, most of the subjects were of advanced age, and the

means for the four groups varied only from 55.5 to 75.6 years. Hence, on the one hand, it was unlikely that a relation between fluoride deposition and age would be apparent; on the other hand, the age factor would tend not to bias any relation between bone fluoride and water fluoride.

From this extensive survey on the fluoride content of human skeletal tissues, it appears that the deposition of fluoride is directly related to the fluoride content of the drinking water up to 4.0 ppm. The deposition of fluoride in dentin and enamel is also elevated proportionately with an increasing concentration of fluoride in the drinking water (27).

There is no indication in these data or in those of previous studies that these human calcified

tissues approach their theoretical capacity of about 3.5 percent fluoride, although drinking water containing as much as 4.0 ppm fluoride was ingested. Prolonged exposure to the water of Colorado Springs, Colo., and Amarillo, Tex. (2.6 ppm fluoride), and to that of Lubbock, Tex. (4.0 ppm fluoride), elevated the fluoride content of the bone ash to a maximum of 1.080 and 1.103 percent, respectively.

The data from the five subjects of Grand Rapids, Mich., are of special interest. Exposure to water containing 1 ppm fluoride did not exceed 12 years, and the average age of the subjects at the time they started to use fluoridated water was about 63 years. Nevertheless, a mean concentration of 0.146 percent fluoride on a dry, fat-free basis was found in these relatively old bones, compared with an average value of 0.049 percent in the bones of individuals of an average age of 56 years ingesting water containing less than 1.0 ppm fluoride.

The fluoride data in the present study coupled with the microscopic findings on essentially the same individuals constitute substantial evidence that a concentration of fluoride as high as 0.548 percent in the dry, fat-free bone and 1.080 percent in the bone ash (for subjects in both studies) may be present without producing any apparent tissue damage.

Summary

Selected bones and skeletal tissue—iliac crest, rib, vertebra, sternum, and intervertebral cartilage—obtained from 69 individuals 26 through 90 years of age who had drunk water containing 0.1 to 4.0 ppm fluoride for at least 10 years were analyzed for ash and fluoride. These bones, which showed no significant histological changes, contained up to 0.548 percent fluoride on a dry, fat-free basis and 1.080 percent fluoride on an ash basis. The mean ash content of the iliac crest and ribs varied from 57.4 to 61.2 percent and that of the sternum and vertebra from 44.6 to 53.7 percent.

At any given level of fluoride in the drinking water, the various bones contained, on a dry, fat-free basis, similar concentrations of fluoride. The fluoride concentration of the intervertebral cartilage was considerably less than that of the bones.

The concentration of fluoride in the bones increased in an essentially linear fashion with an increase of fluoride in the drinking water up to 4.0 ppm.

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Training in Radiological Health

Sanitary Engineering Center. A course in the medical and biological aspects of radiological health will be given at the Robert A. Taft Sanitary Engineering Center, Public Health Service, October 20-31, 1958. Designed for medical, dental, and biological personnel responsible for program decisions in Federal, State, and local health agencies, the course will present data pertinent to radiological health program planning, with emphasis on radiation exposure in the healing arts.

Areas to be covered include biological effects of radiation, philosophy and procedures of radiation protection, practical methods of reducing exposure from medical and dental X-rays, administrative problems of a radiological health program, and the current status of legislative and regulatory procedures.

No previous formal training in radioactivity or radiation is necessary, and there are no tuition or fee charges. Application forms and further information concerning the course may be obtained from the Robert A. Taft Sani-

tary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio.

University of Pittsburgh. Beginning in 1958-59, 2- and 3-year courses in the health aspects of nuclear technology leading to master's and doctor's degrees will be offered by the Graduate School of Public Health. Although focused on occupational and health aspects of nuclear reactors, the new program will cover the fields of health physics and radiation biology. In addition to graduate school facilities, other University Medical Center facilities and some community installations will be used.

Pittsburgh's radiation health training program, located in the department of occupational health, was made possible by a 10-year grant from the Rockefeller Foundation. An additional grant of \$30,000 awarded by the Atomic Energy Commission will be used for equipment and instruments.

Applications and more information may be obtained from the Secretary, Graduate School of Public Health, University of Pittsburgh, Pittsburgh 13, Pa.

Chemical analyses of the bones of two women indicate that human bone may contain as much as 0.5–0.6 percent fluoride without being adversely affected.

Excessive Fluoride in Water and Bone Chemistry

Comparison of two cases

F. J. McCLURE, Ph.D., H. G. McCANN, M.S., and N. C. LEONE, M.D.

CHEMICAL analyses of skeletal tissues of two women have provided new data on the effect on bone composition of excessive amounts of fluoride in drinking water. One of these women, subject A, 74 years old, lived for 24 years prior to death in Washington, D. C., where the drinking water contained 0.2 ppm fluoride. The other, subject B, died at 78 years after 34 years of residence in Bartlett, Tex., where the drinking water contained 8.0 ppm fluoride. Subject B, whose death was caused by a cerebral vascular accident, was a member of a population group previously studied (1). Subject A died of a heart attack.

The ingestion of fluoride and its concomitant occurrence in the animal body has been studied previously and extensively by the analysis of various tissues of cattle, sheep, swine, and small laboratory animals (2–12). Similar data for man, however, are limited and apply practically entirely to the bones and teeth.

The authors are all with the National Institute of Dental Research, Public Health Service. Dr. McClure is chief, and Mr. McCann is a staff member of the Laboratory of Biochemistry. Dr. Leone is chief of medical investigations.

Roholm (2) tabulated the results of the fluoride analyses of human tissues available in the literature up to 1937. His fluoride data, expressed as a percentage of the bone ash, are considered normal for the bones of adults without unusual exposure to the mineral. Values ranged from 0.05 to 0.21 percent fluoride.

He also reported the fluoride content of bones of two men who had been employed in the handling of cryolite and were thereby exposed to excessive quantities of the dust of this fluoride-containing mineral. The ash of bone specimens from these two cryolite workers contained as much as 1.31 percent fluoride.

Boissevain and Drea (13) reported 0.12–0.35 percent fluoride in ash of human rib bones after 15–40 years of exposure to a domestic water containing 2.5 ppm fluoride. They found 0.07 percent fluoride in ash of one human rib with no known exposure to a fluoride drinking water. Linsman and Murray (14) attributed a case of so-called fluoride osteosclerosis to the use of drinking waters containing 4.4–12.0 ppm fluoride. The ash of the sternum and that of lumbar vertebral body were reported to contain 0.69 and 0.75 percent fluoride respectively.

In 1938 Wolff and Kerr (15) analyzed the

skeletal tissues of a man, 48 years of age, exposed almost daily for 18 years to the dust of rock phosphate (3.88 percent fluoride). According to their data, based on 9 different bone specimens, 0.18–0.70 percent fluoride was present in the dry, fat-free bone.

Kilborn and co-workers (16) observed not only a high incidence of mottled enamel in the inhabitants of a remote province of China but also a chronic skeletal disease which they attributed to fluorosis. The drinking water used in two villages contained 6.3 and 5.9 ppm fluoride. A native of one of these villages, a 37-year-old man, was autopsied after accidental death. Sixteen different bones from this man averaged 1.27 percent fluoride in the dry bone and 1.91 percent fluoride in the bone ash. The results varied from 0.97 to 1.50 percent fluoride in dry bone and from 1.47 to 2.20 percent fluoride in bone ash.

The fluoride in the ribs of humans of different ages with no known abnormal exposure to fluoride was studied by Glock and associates (17). Although considerable variation occurred, there is evidence of an increase in skeletal fluoride concomitant with advancing age. Their results, which appear to be somewhat high, are:

Age (years)	Percent fluoride in fat-free bone	Percent fluoride in bone ash
Under 1	0.024	-----
Under 1	.033	-----
2	.06	0.115
15	.088	.174
22	.18	.397
25	.061	-----
27	.28	.591
32	.089	.194
37	.31	.687
37	.15	.280
54	.23	-----
59	.09	.186
60	.23	.473
68	.18	.380

This relation to age has been studied more recently by Smith and associates (18). In the age group 81–90 years, the fluoride in skeletal ash averaged a little more than 0.128 percent but ranged from 0.034 to 0.331 percent for 10 samples of rib and vertebra. Although marked variations thus occurred in the data for individuals of the same chronological age, these authors state that there is “a striking approximation to a linear relationship for the average

bone fluoride concentrations when 10-year age groups are plotted against the logarithm of the age.” These normal accumulations of skeletal fluoride were associated with the use of a drinking water containing 0.06 ppm of fluoride.

In a more recent study, the fluoride content of the iliac crest was found to vary from 0.0164 to 0.0505 percent on dry, fat-free bones in persons aged 32–84 years who had no known exposure to a fluoride water (19). Extensive data on the relation between fluoride in drinking water and fluoride in skeletal tissues are reported by Zipkin and associates (see pp. 732–740 of this issue of *Public Health Reports*).

It is evident from these bone analyses that fluoride may accumulate in skeletal tissues concomitant with the ingestion of fluoride. The presence of relatively large quantities of fluoride in drinking water would be expected to cause marked increases in skeletal fluoride after a prolonged exposure. This was found to have occurred in the woman of this study exposed to high-level fluoride water.

While a major interest in the chemistry of these human skeletal tissues is the extent of fluoride accumulations, it was our purpose also to throw some light on the relation of fluoride to other bone elements, particularly those concerned with calcification. Accordingly, the ash, calcium, phosphorus, magnesium, and carbon dioxide contents of the bones were determined.

Methods and Results of Analyses

For the chemical analyses, the bones were reduced to small pieces; the fat was extracted with alcohol and ether; and the sample was ground to pass a 60-mesh sieve and then dried at 110° C. A temperature of 600° C. was maintained in the electric muffle furnace for ashing. Fluoride was determined on the ashed samples by standard procedures (20, 21), which require steam distillation using perchloric acid and titration of the fluoride evolved in the distillate with standard thorium nitrate. In addition to fluoride, calcium was determined on the ashed samples by triple precipitation of the oxalate from acid solution by slow addition of NH_4OH to avoid contamination with phosphate and to assure good separation of mag-

Table 1. Composition of skeletal tissues (dry, fat-free) of two adults with extremes of fluoride exposure

Bone specimen	Percent ash		Percent calcium		Percent phosphorus		Calcium/phosphorus		Percent magnesium		Percent carbon dioxide		Percent fluoride	
	A ¹	B ²	A	B	A	B	A	B	A	B	A	B	A	B
Femur.....	68.73	70.94	26.46	26.71	11.70	11.71	2.26	2.28	0.37	0.35	3.93	3.95	0.062	0.551
Tibia.....	65.14	---	24.92	---	11.11	---	2.24	---	.38	---	3.44	---	.067	---
Fibula.....	57.43	71.65	20.92	26.97	9.24	11.81	2.26	2.28	.49	.34	---	4.00	.080	.512
Calvarium.....	68.10	71.44	26.12	26.79	11.61	11.87	2.25	2.26	.36	.39	3.70	3.96	.092	.653
Lumbar vertebra.....	43.39	60.24	15.69	22.38	7.46	9.45	2.10	2.37	.48	.34	1.48	3.42	.077	.550
Thoracic vertebra.....	---	60.84	---	22.66	---	10.01	---	2.26	---	.33	---	3.41	---	.550
Dorsal vertebra.....	46.38	---	16.72	---	7.50	---	2.33	---	.31	---	2.39	---	.086	---
Miscellaneous vertebra.....	---	58.82	---	21.90	---	9.53	---	2.30	---	.33	---	3.15	---	.530
Rib.....	54.78	66.92	21.10	25.16	9.50	11.01	2.22	2.29	.35	.35	2.92	3.83	.089	.630
Right pelvis.....	---	67.53	---	24.56	---	10.79	---	2.28	---	.32	---	3.88	---	.577
Acromioclavicular joint.....	---	55.86	---	20.27	---	8.84	---	2.29	---	.32	---	3.19	---	.540
Crest of ilium.....	57.77	---	21.90	---	9.81	---	2.23	---	.36	---	2.93	---	.078	---
Intervertebral cartilage.....	6.72	5.19	1.72	.61	.63	.29	2.73	2.10	.13	.15	.00	.20	.006	.011

¹ Washington, D. C., resident; 0.2 ppm fluoride in drinking water.

² Bartlett, Tex., resident; 8.0 ppm fluoride in drinking water.

nesium (22). Final weighing was as CaF_2 . Magnesium was determined in the filtrate by double precipitation as magnesium ammonium phosphate. Phosphorus was determined on the unashed sample by the molybdovanadophosphate differential spectrophotometric method (23). Carbon dioxide was determined on the unashed samples by evolution with HClO_4 , and absorption of the dried gas in a weighing bulb, a modification of the standard procedure (22).

In table 1 the analytical data are presented

on the dry, fat-free bone. As might be expected, the most remarkable difference in the chemical content of the bones of these two aged adults lies in the fluoride. As much as 0.653 percent fluoride was present in the calvarium of the Bartlett woman, subject B, with a minimum of 0.512 percent fluoride present in the fibula. In striking contrast, the maximum percentage of fluoride in the skeletal tissues of the control, the nonfluoride subject A, was 0.092 percent in the calvarium. The fluoride concen-

Table 2. Composition of bone ash of two adults with extremes of fluoride exposure

Bone specimen	Percent calcium		Percent phosphorus		Calcium/phosphorus		Percent magnesium		Percent carbon dioxide		Percent fluoride	
	A ¹	B ²	A	B	A	B	A	B	A	B	A	B
Femur.....	38.49	37.65	17.02	16.51	2.26	2.28	0.53	0.49	5.72	5.57	0.090	0.771
Tibia.....	38.25	---	17.06	---	2.24	---	.58	---	5.28	---	.103	---
Fibula.....	36.43	37.64	16.09	16.48	2.26	2.28	.85	.47	---	5.58	.139	.715
Calvarium.....	38.36	37.50	17.05	16.62	2.25	2.26	.53	.55	5.43	5.54	.135	.914
Lumbar vertebra.....	36.16	37.15	17.19	15.69	2.10	2.37	1.11	.56	3.41	5.68	.177	.913
Thoracic vertebra.....	---	37.25	---	16.45	---	2.26	---	.54	---	5.60	---	.904
Dorsal vertebra.....	36.05	---	16.17	---	2.23	---	.67	---	5.15	---	.185	---
Miscellaneous vertebra.....	---	37.23	---	16.20	---	2.30	---	.56	---	5.36	---	.901
Rib.....	38.52	37.60	17.34	16.45	2.22	2.29	.64	.52	5.33	5.72	.162	.941
Right pelvis.....	---	36.37	---	15.98	---	2.28	---	.47	---	5.75	---	.855
Acromioclavicular joint.....	---	36.29	---	15.83	---	2.29	---	.61	---	5.71	---	.966
Crest of ilium.....	37.91	---	16.98	---	2.23	---	.62	---	5.07	---	.135	---

¹ Washington, D. C., resident; 0.2 ppm fluoride in drinking water.

² Bartlett, Tex., resident; 8.0 ppm fluoride in drinking water.

trations in all the different dry, fat-free bone specimens were relatively constant.

Table 2 shows the percentage composition of the bone ash of the two women. It will be noted that the femur and fibula ash of B contained somewhat less fluoride, 0.771 percent and 0.715 percent respectively, than did the other specimens of bone ash of B, which were quite uniform and ranged from 0.855 to 0.966 percent fluoride. The femur ash of A also contained less fluoride than did the ash of other bones. One explanation of this observation may be the higher ash content of these bones.

Some differences in the ash, calcium, and perhaps phosphorus, in addition to fluoride, in the dry, fat-free bones of these two particular women occurred (table 1). In 5 possible comparisons of the same bones from these 2 similar individuals, more ash, calcium, and phosphorus were contained in the bone specimens of B than in those of A. These differences are most pronounced with respect to ash and calcium. There is a suggestion of some elevation in percentage of carbon dioxide in the bones of B compared with A. The calcium-phosphorus ratio and the magnesium content of the two subjects were comparable.

Discussion

The results of the fluoride analyses of these human skeletal tissues agree with previous experimental and clinical evidence that skeletal

tissues become an extensive depository of fluoride. The fluoride accumulations found in B resulted from the prolonged use of a drinking water containing an excessively high concentration of fluoride. As indicated by comparison of the data for these two subjects, this accumulation of fluoride increased slightly the calcification of skeletal tissue.

The ash and perhaps the calcium of dry, fat-free bones of B were slightly higher than the ash and calcium in normal human bones, as shown in table 3. Fluoride analyses of the bone specimens from normal subjects, previously studied by Illinois investigators (24-26), were made at the National Institute of Dental Research. Analytical data for the individual bones of A and B have been averaged and are presented for comparison with the other findings.

There is a remarkably close agreement among the data obtained on the normal men and on our own normal subject A. Whereas the ash values of the bones from these subjects varied from 56.67 to 57.85 percent, the ash content of the bones of subject B averaged 64.91 percent. The calcium averaged 24.16 percent compared with a variation of 21.26 to 22.84 percent in adult bone exposed to low-fluoride water. There is no indication of an effect of fluoride on the calcium, phosphorus, and calcium-phosphorus ratio of the bone ash.

It seems evident, considering the data in table 3, that a slight increase in calcification did occur

Table 3. Comparison of composition of human skeletal tissue exposed to normal and high-fluoride water.

Subject and exposure	Dry, fat-free bone					Bone ash	
	Percent fluoride	Percent ash	Percent calcium	Percent phosphorus	Calcium/phosphorus	Percent calcium	Percent phosphorus
Normal water fluoride:							
Male, 35 years ¹		56.67	21.61	9.48	2.28	38.13	16.72
Male, 46 years ²	0.037	56.89	22.81	9.86	2.31	40.09	17.33
Male, 60 years ³	.038	56.93	21.26	10.08	2.11	37.34	17.70
Male, 48 years ³	.077	57.85	22.84	10.30	2.22	39.48	17.80
Female A, 74 years	.079	57.71	21.72	9.74	2.23	37.63	16.87
Average of normal exposures	.058	57.21	22.04	9.89	2.23	38.53	17.28
8.0 ppm water fluoride:							
Female B, 78 years	.556	64.91	24.16	10.55	2.27	37.22	16.25

¹ Reference 24.

² Reference 25.

³ Reference 26.

in the skeletal tissues of B. This is regarded as the result of exposure to excessive water-borne fluoride.

Bone Pathology and Fluoride Content

For previous evidence bearing on the relationship between fluoride content and pathological changes in human bone tissues, we must refer to the early classic studies of Roholm (2). The two autopsy cases he studied represent the characteristic skeletal pathology produced by excessive fluoride. The abnormalities were concomitant with 0.76 to 1.319 percent fluoride present in the ash of the affected bones. An unusually low value of 0.31 percent fluoride is reported for the frontal bone of 1 of these 2 cryolite workers.

The deleterious effects of fluoride, observed in experimental animal studies, have resulted consistently from excessive fluoride exposures, and the observations supply substantial information concerning the relationship between bone fluoride and bone pathology. Swine bones, according to Kick and associates (3), retained upwards of 0.30–0.40 percent fluoride before any toxic effects of fluoride were discernible. In the bones of dairy cattle suffering from extreme fluorosis, the severity of bone exostosis increased directly with the fluoride content, a mild form of exostosis being associated with 0.53 percent fluoride in the bone tissue (9).

Recently Suttie and associates (27) reported that dairy cows tolerated the ingestion of 30 ppm of fluoride in the diet, with a concomitant accumulation of 0.46 percent fluoride in dry, fat-free rib bones. On the basis of the evidence that 0.01–0.15 percent fluorine is present normally in the bone ash of animals, Peirce (6) suggested that the "ingestion of quantities of fluorine which apparently exert no untoward effects on the general health of animals or which bring about no obvious morphological change in its skeleton, may nevertheless increase ten- to fifteen-fold the fluorine content of bones and teeth."

The data available through the present study provide additional evidence regarding the threshold level of fluoride which may be tolerated by human skeletal tissues. As much as 0.5–0.6 percent fluoride in the bones of B did not

prove to be a physiological hazard. This is about 10 times the quantity of fluoride regarded as normal. X-ray examination, medical, and clinical studies made prior to the death of B (1, 28) do not reveal any skeletal abnormalities or systemic conditions of consequence to health or well-being which could be directly associated with the remarkable increases in the skeletal fluoride content. Other reports contain extensive information on the relation between fluoride content and bone pathology (see pp. 721–731 and 732–740 of this issue).

It must be concluded in the light of the available evidence that human skeletal tissue may have a very high degree of physiological tolerance to accumulations of fluoride.

Summary

Analytic chemical studies of similar human skeletal tissues obtained at autopsy from two comparable women were conducted to determine the effect of a prolonged exposure to drinking water containing 8.0 ppm of fluoride on the chemistry of human bones.

As a result of the prolonged use of this fluoride drinking water, the fluoride in dry, fat-free skeletal tissues ranged from 0.512 to 0.653 percent, as compared with 0.062 to 0.092 percent fluoride in the skeletal tissues of a subject, comparable in age, height, weight, and sex, with no unusual water-fluoride exposure.

There was some indication that the prolonged use of drinking water containing 8.0 ppm fluoride accounted for an increase in the ash and a slight increase in the calcium content of the skeletal tissues.

The absence of any gross or systemic findings, or of any impairment of health or well-being, malformation of the skeletal tissues, or malfunction generally in the one subject studied, indicates that human bone may not be affected by as much as 0.5 to 0.6 percent fluoride. These findings compare favorably with other previous evidence pertinent to human bone as well as fluorosed animal bones.

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TRACE ELEMENTS in BIOLOGY and AGRICULTURE

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FOODS and nutrients are necessary for cell growth because of their function in generation or release of energy, building and repair of protoplasm, and regulation of metabolic processes. They are usually classified as: (a) an energy source, (b) a nitrogen source, (c) growth factors (organic compounds not synthesized by the organism and required usually in small amounts), and (d) mineral salt or inorganic nutrient.

A number of inorganic elements, or minerals, are required by all living forms for normal growth and reproduction. This is not true of all the elements of the periodic table, although most have been found in living cells. The minerals essential to life are generally divided into two classes: macronutrients, or major elements, needed in relatively large amounts, and the micronutrients, or trace elements, required only in small amounts.

For most organisms the macronutrient elements include sulphur, phosphorus, potassium, magnesium, calcium, and nitrogen. In addition, sodium and chloride are needed by animals and, according to recent experiments, probably by plants as well. The trace elements include iron, zinc, manganese, and copper. Molybdenum, boron, and vanadium are

also needed by plants, and iodine, cobalt, and probably molybdenum by animals. Even though micronutrient elements are required in only extremely small quantities, they are no less important than the major elements.

The fact that the trace metals are needed in only small quantities indicates that they are functioning in some catalytic role, usually as part of an enzyme system. In this respect the function of trace elements is similar to that of the organic micronutrients, the vitamins. A known enzymatic role has been described for most of the trace elements. Exceptions are iodine, which is a component of the thyroglobulin molecule, and cobalt, which is part of the vitamin B₁₂ molecule.

Although we can describe a specific function for most of the metals, as long as essential enzyme systems can be activated by a variety of elements we can expect nonessential metals to have a significant effect on the metabolism of plants and animals. There are many examples of multiple-metal effects on enzyme systems, some of the most striking of which are from the area of plant-animal relationship. Judging by the optimum concentration of an element for enzyme activity as well as the ratio of stimulatory and inhibitory metals present, it is evident that under physiological conditions some systems may be working at a maximum rate whereas others may be operating at less than 1 percent of maximum efficiency.

Obviously there must be some balance in the

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soil, in the plant, and in the animal which leads to a normal, healthy individual. However, the difficulty of determining the normal activator of a metabolic system and factors which will influence the rate of reaction in vivo is demonstrated by a number of recent experiments.

Is growth or yield an adequate criterion for determining whether the various metabolic systems are functioning at a level to give maximum benefit to the organism? Can we apply trace elements and other fertilizers to the soil and to the diets of animals until we obtain maximum crop yield or maximum growth rate and expect, at the same time, to receive maximum nutritional benefit for the organisms? There are several excellent examples which say we cannot. One might say that these are extreme and special cases. However, it is gradually becoming evident that visual symptoms of plant and animal deficiency are not necessary to prove deficiencies in the health and vigor of the organism. Deficiencies and excesses are a matter of degree, and plants, like animals, may become decidedly inferior in quality long before showing outward signs. Hence, yield or growth is no longer an adequate sign of health.

The next question is, what criteria can be used? From a physiological point of view, criteria must by necessity vary with the nature of the objective. If it is aroma in tobacco that is desired, then a plant that is slightly deficient in sulphur may be essential. If it is tensile strength and kink in wool, then the dietary level of copper may be one of the major factors. Many other examples could be cited.

What seems clear from numerous studies is that certain metabolic characteristics appear under conditions of varying trace-element supply and not merely in association with an overall reduction or increase in mass or quantity. In other words, each level of trace-element supply during growth produces a characteristic metabolic pattern irrespective of the yield. The enzymatic patterns are the real test. Enzyme concentration and activity are changing under all conditions of trace-element nutrition. These changes of enzymatic activity will certainly be of value in the early diagnosis of animal and plant diseases which are not apparent from growth studies, and, as Williams

recently emphasized, each individual represents a special problem (1).

Several general patterns evolve from the physico-chemical and nutritional studies on the influence and mechanism of action of metals in enzyme systems. Although there are exceptions to these generalizations, it appears that those metals most closely associated with electron transferring systems are copper, iron, zinc, and molybdenum. Nonenzymatic studies have shown that these metals have the inherent capacity to function as electron mediators in oxidation-reduction reactions. The important biochemical questions are: (a) why is this capacity for catalyzing oxidation-reduction reactions accentuated in the presence of specific proteins, and (b) what is the nature of the linkages which allow specific coupling of these metal systems to others, which in turn allows the transfer of electrons along specific pathways? The pattern that seems to be emerging is that these metals are not required specifically for the combination of substrate to the catalytic protein but rather that they function primarily as "electron couplers" from one protein system to another.

Tabulated results of studies show that magnesium and, to a certain extent, manganese are required primarily for those reactions involving group transfer, in particular those in which phosphate participates. For example, to metabolize glucose it must be phosphorylated. Phosphate is transferred from adenosine triphosphate to glucose to form glucose-6-phosphate and adenosine diphosphate. Magnesium is required for this group transfer. In recent years it has become increasingly clear that enzymes participate intimately in group transfer by serving as the intermediate carrier. Magnesium plays a predominant role in promoting the formation of the enzyme-substrate complex and the resulting intermediate of the reaction. The presence of a pyrophosphate structure in many of the co-factors and substrates involved in group transfer suggests that a chelate structure with magnesium is probable.

The predominant metal in general enzymatic decarboxylation and hydrolysis reactions is manganese. To a lesser extent zinc and magnesium also are factors. At present there is no general agreement as to the primary mechanism

of action of these metals. Some workers feel that they form an essential structure with the substrate and thus act to bring the substrate into combination with the protein. Others feel that the metal combines with the enzyme and functions primarily to accelerate and therefore to increase the concentration of an essential intermediate in the reaction. Manganese does not have strong inherent properties for catalyzing decarboxylation, whereas other metals, such as copper, which do not function as co-factors in enzymatic decarboxylation, are very effective in nonenzymatic reactions. The suggestion, therefore, that manganese functions in enzyme systems by forming chelate structures with the substrate lacks strong experimental support.

Conclusion

Emphasis in nutrition during the past 30 years has been on identification and establishment of absolute requirements of inorganic and

organic nutrients for "normal" growth and development. Almost by necessity it was assumed that the animals in a population were all identical and therefore had the same nutritional requirements. It is now clear, however, that there are large individual variations in nutritional requirements. In addition, quantitative studies on various tissues indicate that small changes in the diet often lead to dramatic effects on enzyme systems. Thus studies in the future must emphasize the individual.

Nutritional individuality can be an important factor in human health and disease. Small changes in concentration of the trace elements in the diet, for example, will alter the concentration of metabolic intermediates and products formed by an individual. Growth alone, therefore, is not the only criterion that can be used for testing the adequacies of a diet.

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Allocation of Charity Funds for Research

The voluntary health agencies listed below in the United States raised \$116,788,220 in 1956, according to the National Health Education Committee, Inc., New York City. In the same year, \$20,918,043 was allocated for research by the agencies.

Voluntary agency	Amount raised	Amount allocated for research
American Cancer Society	\$27, 234, 612	\$7, 735, 537
Damon Runyon Fund	984, 743	1, 006, 033
American Heart Association and affiliates	17, 755, 910	¹ 6, 100, 000
National Association for Mental Health	695, 054	² 149, 007
Arthritis and Rheumatism Foundation	2, 449, 396	467, 521
United Cerebral Palsy	8, 318, 000	538, 865
National Multiple Sclerosis Society	2, 007, 606	² 270, 805
Muscular Dystrophy Associations	4, 191, 109	1, 405, 415
National Council to Combat Blindness	257, 915	127, 954
National Society for the Prevention of Blindness	255, 902	47, 667
American Foundation for the Blind	666, 973	none
National Foundation for Infantile Paralysis	51, 971, 000	3, 069, 239
Total	116, 788, 220	20, 918, 043

¹ Not final. ² National office figures only.

Mortality in mental hospital patients is analyzed in an exploration of its relation to changes in the general pattern of mortality.

Mortality in State Mental Hospitals of Michigan, 1950-54

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MODERN science has not only extended average life but also has markedly affected the pattern of mortality in the United States. The effect of demographic factors associated with mental patients on an overall mortality rate and the trends and characteristics of mental hospital mortality have become subjects of interest and curiosity among professional investigators in the mental health field, including demographers (1-5).

The present study compares differential mortality rates among resident patients in Michigan State mental hospitals with those in the general population of Michigan during a 5-year period beginning in 1950. The source for the data on mortality of mental patients is the statistics section of the Michigan Department of Mental Health. Figures for the general population of Michigan for 1950 are from the United States census. To compute death rates, the number of resident patients and the number of people in communities as of June 30 were used as denominators. Analyses and discussions of the data are presented in the following order. First, age-sex composition of the population in order to provide the basic information that would facilitate intelligent discussion of the differential mortality rates observed in two different environments. Second, trends and characteristics of the mortality rates by all

causes of death. Third, trends and characteristics of the mortality rates by selected causes of death. Fourth, diagnosis-specific death rates among patients with different mental disorders. Fifth, psychiatric hospital mortality from the point of view of physical condition and age of patients on admission to the hospital.

Population Characteristics and Deaths

It is estimated that, during the 1950-54 period under study, Michigan's total population increased from 6,371,766 to 7,156,481, or by 12.3 percent. During this period total deaths in Michigan increased from 57,743 to 60,632 or by 5 percent. These changes led to a shift in the crude death rate, which declined from 9.1 to 8.6 per 1,000 of the State population.

In contrast, the number of resident patients in Michigan State mental hospitals increased from 18,738 to 20,031, or by 6.5 percent, while the number of deaths occurring in the hospitals during the same period decreased from 1,455 to 1,348, or by 7.4 percent. This brought about a sharp decline in the crude death rate for the patients from 77.6 in 1950 to 67.2 in 1954.

Examination of the available data indicates that patient movement during the quinquennium has shifted toward the hospitalization of increasingly more women than men in the middle and old age groups. Conversely, there has been increasingly more men than women of young ages in the hospitals for psychiatric treatment.

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Comparison of the general population with the patient population points up two obvious distinctions in the age composition. In the patient population there is an actual and proportionate preponderance in the middle and old age groups, with an extremely small number and proportion of people under 20 years of age, while in the general population, the largest proportion and number is in the youngest age group with a diminishing proportion as the age groups advance. On the other hand, the psychiatric hospital population usually consists of a large proportion of two distinctive diagnostic groups, namely, the schizophrenic patients who are mostly in the productive age groups, and the patients suffering from psychoses associated with senility.

Crude Death Rates by All Causes

The crude death rate, measured as the number of deaths per 1,000 of the total population, usually cannot be taken as an accurate index of the true mortality of the population. However, analyses and discussions of such rates are presented because of their pragmatic utility for health authorities.

Although the hospital population experienced a considerable decrease in the overall death rate, the data reveal no clear-cut and consistent pattern of change. It should be noted, however, that such an overall rate decline was actually accounted for by a remarkable drop in the rate of male patients during this period. Thus, it follows that, although male patients are gener-

ally subjected to a higher mortality than female patients, the death rate difference between the two sexes became continuously less important. On the basis of the 5-year average, approximately 20 more male than female patients per 1,000 died in the course of 1 year.

According to the data in table 1, the magnitude of decrease in the death rate is positively related to the age of the group. Particularly noted are the patients aged 65 and over, who recorded the sharpest decline, from 197.9 to 172.8, a drop of more than 25 deaths per 1,000. With male patients the death rate declined more in the older group than in the younger group, while the reverse was true with female patients, who showed a sharper rate drop in the younger group.

In sharp contrast to what was observed in the hospital population, the general population on the whole did not show a noticeable change in the crude death rate during the period being observed. In fact, in the general population the overall death rate for all causes remained almost unchanged at the level of 10-11 per 1,000. As expected, the male population as a whole always maintained a slightly higher rate of mortality than did the female population. On the 5-year average approximately four more men than women per 1,000 died yearly. Furthermore, both sexes managed to hold a fairly consistent relative position of the rate throughout the entire quinquennium.

The data in table 2 also reveal that the crude death rate for all causes in the general population declined steadily, but slightly, in each of

Table 1. Crude death rate by all causes per 1,000 resident patients, by three broad age groups and sex, 1950-54

Year	Rate by sex			Rate by sex and age group								
				Total			Male			Female		
	Total	Male	Female	15-34	35-64	65 and over	15-34	35-64	65 and over	15-34	35-64	65 and over
1950.....	77.7	93.6	62.2	15.2	38.0	197.9	15.4	47.7	248.1	15.1	28.2	154.3
1951.....	83.8	91.3	76.5	15.6	37.4	221.6	17.8	40.7	247.9	13.4	34.0	197.6
1952.....	71.6	81.2	62.2	12.6	31.6	188.0	14.5	38.0	214.7	10.6	25.2	163.8
1953.....	73.8	85.9	62.2	11.2	31.9	185.3	13.1	39.1	217.4	9.2	24.9	156.4
1954.....	67.5	74.2	61.1	8.7	29.2	172.8	10.2	33.0	193.6	7.2	25.5	154.3
Average.....	74.9	85.2	64.8	12.7	33.6	193.1	14.2	39.7	224.3	11.1	27.6	165.3

Table 2. Crude death rate by all causes per 1,000 for general population, by three broad age groups and sex, 1950-54

Year	Rate by sex			Rate by sex and age group								
				Total			Male			Female		
	Total	Male	Female	15-34	35-64	65 and over	15-34	35-64	65 and over	15-34	35-64	65 and over
1950	11.0	12.8	9.1	1.4	8.9	62.3	1.7	11.1	69.7	1.1	6.6	55.2
1951	11.1	12.8	9.3	1.3	8.8	61.8	1.6	10.9	68.5	1.0	6.6	55.4
1952	10.9	12.7	9.1	1.3	8.7	58.8	1.7	10.8	65.3	.9	6.4	52.5
1953	11.3	13.2	9.3	1.4	8.6	60.7	1.8	10.9	67.7	1.0	6.3	54.0
1954	10.9	12.8	8.9	1.2	8.2	57.9	1.6	10.4	64.9	.8	5.8	51.2
Average	11.0	12.9	9.1	1.3	8.6	60.3	1.7	10.8	67.2	1.0	6.3	53.7

the three broad age groups during the same period. It was found, as in the case of hospital mortality, that the magnitude of a quinquennial rate decline was largest in the oldest age group. Differences in the crude death rates as observed between men and women in the general population seem far less significant than those observed in the hospital population.

In view of the extremely contrasting characteristics of the age-sex composition of the two populations, it was assumed that the crude rate of hospital mortality would far exceed that of general mortality. According to the 5-year average rates, the hospital mortality was found to be 6.8 times as high as the general mortality,

while the difference was slightly greater for the female (7.1 times) than for the male (6.6 times) population. The death rate difference between the two populations was found to be much greater in the young than in the old group.

Age-Sex Specific and Standardized Rates

Examination of the data in table 3 indicates that in both populations the age-specific and age-sex specific death rates rise increasingly with advance in age. The age-sex specific rate is measured as the number of deaths of a given age-sex group per 1,000 of the population of that age-sex group. Similar to Malzberg's

Table 3. Age-specific and age-sex specific death rate per 1,000 of mental hospital population and general population, 1950-54 average

Age group	Age-sex specific death rate and ratio								
	Total			Male			Female		
	Mental hospitals	General population	Ratio	Mental hospitals	General population	Ratio	Mental hospitals	General population	Ratio
20-24	16.4	1.24	13.2	18.6	1.70	10.9	13.9	0.80	17.4
25-29	11.5	1.32	8.7	12.8	1.67	7.7	10.2	.98	10.4
30-34	12.3	1.68	7.3	13.8	2.01	6.9	11.0	1.36	8.1
35-39	12.7	2.45	5.2	14.3	2.88	5.0	11.2	2.02	5.5
40-44	16.3	3.87	4.2	14.9	4.53	3.3	17.8	3.20	5.6
45-49	22.0	6.21	3.5	25.3	7.56	3.3	18.4	4.78	3.8
50-54	30.3	9.77	3.1	36.0	12.15	3.0	25.0	7.20	3.5
55-59	42.0	14.97	2.8	51.8	19.01	2.7	33.4	10.56	3.2
60-64	72.6	22.74	3.2	90.0	28.56	3.2	55.1	16.41	3.4
65-69	95.8	33.55	2.9	110.0	41.00	2.7	80.4	25.91	3.1
70-74	161.6	49.35	3.3	197.5	58.23	3.4	127.3	40.80	3.1
75 and over	301.1	104.73	2.9	376.1	112.99	3.3	248.0	97.62	2.5

Table 4. Standardized death rate per 1,000 for resident patients, by three broad age groups and sex, 1950-54

Year	Standardized ¹ rate by sex			Standardized ¹ rate by sex and age group								
				Total ⁴			Male ⁵			Female ⁵		
	Total ²	Male ³	Female ³	20-34	35-64	65 and over	20-34	35-64	65 and over	20-34	35-64	65 and over
1950-----	39.4	48.8	30.9	15.0	31.7	178.5	15.2	39.0	235.0	14.8	24.3	130.7
1951-----	42.0	47.7	37.0	16.5	30.9	204.2	19.1	33.6	238.6	13.5	28.3	177.3
1952-----	35.3	41.5	29.8	13.2	26.6	170.7	14.7	31.2	204.0	11.8	22.2	142.5
1953-----	35.1	42.8	28.4	13.8	25.5	172.4	16.1	31.0	213.4	11.7	20.4	138.7
1954-----	31.2	36.1	26.8	8.7	23.8	160.4	10.7	26.4	189.9	6.9	21.3	135.5
Average-----	36.6	43.4	30.6	13.4	27.7	177.2	15.2	32.2	216.1	11.7	23.3	144.9

¹ Michigan 1940 population used as standard. ² Rates standardized for sex and age. ³ Rates standardized for age. ⁴ Rates standardized for sex and age in a segment of population. ⁵ Rates standardized for age in a segment of population.

findings (6), the largest relative difference in the age-specific and age-sex specific death rates between hospital and general populations was found in the young (20-24) age group. Most important, these specific rates of resident patients were always higher than those of the general population in every age group used in the table.

The mortality trend observed in the hospitals, as indicated by the standardized death rates, was a steady downward movement. The standardized rate is measured per 1,000 of the selected standard population with the adjust-

ment for age or age and sex. From the point of view of demographic significance, this drop is a remarkable change which took place within a period of 5 years beginning in 1950. There was also a considerable rate difference between the patients of different sexes, with the male patients showing a much greater decrease in adjusted mortality than did female patients during the same period.

In all age groups there was a steady and favorable trend in the adjusted mortality. In comparing the three age groups, it was found that the old age group showed a greater decrease

Table 5. Standardized death rate per 1,000 for general population, by three broad age groups and sex, 1950-54

Year	Standardized ¹ rate by sex			Standardized ¹ rate by sex and age group								
				Total ⁴			Male ⁵			Female ⁵		
	Total ²	Male ³	Female ³	20-34	35-64	65 and over	20-34	35-64	65 and over	20-34	35-64	65 and over
1950-----	11.0	13.0	9.0	1.5	8.5	62.3	1.8	10.4	71.0	1.1	6.4	54.1
1951-----	10.8	12.7	8.9	1.4	8.4	61.7	1.7	10.3	69.6	1.1	6.4	54.1
1952-----	10.4	12.3	8.5	1.4	8.3	58.3	1.7	10.2	66.0	1.0	6.2	50.9
1953-----	10.6	12.6	8.6	1.5	8.2	59.9	1.9	10.3	68.0	1.0	6.1	52.1
1954-----	10.0	12.0	8.0	1.3	7.8	56.8	1.7	9.9	64.9	.9	5.7	49.1
Average-----	10.6	12.5	8.6	1.4	8.2	59.8	1.8	10.2	67.9	1.0	6.2	52.1

¹ Michigan 1940 population used as standard. ² Rates standardized for sex and age. ³ Rates standardized for age. ⁴ Rates standardized for sex and age in a segment of population. ⁵ Rates standardized for age in a segment of population.

in the mortality rate than did the middle and young age groups.

In terms of adjusted mortality rate, it should be noted that the amount of improvement made by the young female patients was about twice that experienced by young male patients during the 5 years. In contrast, the pattern of such progress was reversed for the male patients in the middle and old age groups. In general the improvement on life expectancy of male patients was much greater than that of the female patients, with a consequent decreasing sex difference in the mortality rate among resident patients.

In short, it is apparent upon examination of the standardized death rates presented in the table that the downward movement of the mortality observed in State mental hospitals was not due to change in age-sex composition of the resident patient population. Rather it was because of the favorable impact of other environmental factors, or such factors as selective intake of patients so that the patients admitted in later years had a smaller risk of death, or to improvement in therapy which enabled patients to accept improved diets, thus improving their health.

In a 5-year comparison of the two popula-

tions, the adjusted hospital mortality rate was found to be 3.6 times as high as the adjusted general mortality rate (table 5), while no overall sex difference was noted. The greatest adjusted rate difference was found in the group aged 20-34 years, although such a discrepancy became consistently smaller during this period.

Crude Cause-Specific Rates

For the purposes of this paper, the definition of a cause of death, taken from the Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, is "the morbid condition or disease process, abnormality, injury or poisoning leading directly, or indirectly, to death." A systematic classification of the causes of death as tabulated in the detailed list of the International List of Causes of Death was used in this study, and discussion of the basic mortality characteristics and trends is limited to the 12 leading causes of death. The cause-specific rate is measured as the number of deaths from a given disease per 100,000 of the total population.

The causes of death for patients in State mental hospitals show striking variations when compared with those for the general population.

Table 6. Percentage distribution of deaths by 12 leading causes for hospital population and general population, 1950-54

Major causes of death	Hospital population					General population				
	1950	1951	1952	1953	1954	1950	1951	1952	1953	1954
Tuberculosis (001-008, 010-019)-----	3.8	4.1	2.6	2.9	1.9	2.2	1.9	1.3	0.9	0.9
Syphilis (020-029)-----	.3	.3	.2	.5	.7	.8	.5	.3	.3	.2
Malignant neoplasms (140-205)-----	4.3	3.1	4.2	4.9	5.8	15.4	15.9	15.9	16.2	16.9
Diabetes mellitus (260)-----	.1	.2	.5	.3	.6	2.6	2.4	2.3	2.3	2.5
Vascular lesions (330-334)-----	8.4	10.5	10.4	12.3	18.1	11.1	11.1	11.1	11.3	11.3
Arteriosclerotic and degenerative heart disease (420-422)-----	33.4	30.6	37.7	32.9	25.5	27.7	28.4	28.0	29.1	29.7
Hypertension (440-447)-----	1.4	1.9	4.8	4.9	1.8	5.6	5.3	5.4	5.2	4.9
Pneumonia (490-493)-----	16.2	16.9	17.4	15.5	15.8	2.0	2.3	2.3	4.7	2.0
Cirrhosis of liver (581)-----	.4	.1	.2	.5	.3	1.1	1.0	1.0	1.2	1.1
Nephritis and nephrosis (590-594)-----	2.1	2.2	1.7	1.4	.5	1.8	1.7	1.5	2.7	1.2
Suicide and self-inflicted injury (970-979)-----	.6	.5	.2	.2	.2	1.3	1.1	1.2	1.2	1.2
Accidental deaths (800-802, 810-835, 840-965, 980-984)-----	.4	.5	.5	1.5	.7	7.1	7.2	7.1	7.5	7.0
Subtotal-----	71.4	70.9	80.4	77.8	71.9	78.7	78.8	77.4	82.6	78.9
Other causes-----	28.6	29.1	19.6	22.2	28.1	21.3	21.2	22.6	17.4	21.1
Total-----	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

NOTE: Numbers in parentheses are category numbers of the International Statistical Classification, 1948.

Table 6 shows a percentage distribution of deaths by 12 leading causes for hospital and general populations respectively. In both populations, arteriosclerotic and degenerative heart disease ranked the highest among the 12 leading causes but, in the course of 5 years, the relative importance of heart disease as a cause of death has gradually and significantly decreased in mental hospitals as compared with an opposite trend observed in general communities. This may be partially explained by an increase of the incidence and mortality of vascular lesions affecting the central nervous system among patients, which has actually inflated the proportion by nearly 10 percent during the period covered by this study. While malignant neoplasms rank fourth as a cause of death in the mental hospitals as compared with second in the general population, the crude death rate for this cause among mental patients is greater than that in the general population. Pneumonia, which has become increasingly unimportant as a cause of death in the general population, is still one of the most frequent causes of patient deaths. The concentration of deaths among a few leading causes was much greater

for the hospital population than for general communities.

Table 7 provides the standardized cause-specific death rates per 100,000 of each of the hospital and general populations by sex.

There has been a steady, and general, decline in the importance of tuberculosis as a leading cause of death, although it has consistently maintained a much greater importance in the hospital population. To be specific, the death rate in hospitals dropped from 293.4 to 116.2 in the course of 5 years, while in communities it declined from 27.2 to 11.1. In general, the mortality rate of this disease was considerably higher for men than for women. However, the rate difference between the two sexes was not as distinct in the hospital population as in the general population. Syphilis and its sequelae were relatively unimportant as a cause of death in both populations, but while the rate declined from 10.5 to 2.9 in the general population, there was a rise from 26.9 to 40.4 among the patients during the 5-year period. This is explained by a sharp rise in mortality from this disease in aged patients, particularly among older male patients.

Table 7. Standardized cause-specific death rate per 100,000 for hospital population and general population by sex, 1950-54 average

[Age group under 20 is excluded]

Cause of death ¹	Standardized ² death rate						Ratio of the hospital death rate to the general death rate by sex		
	Mental hospitals			General population					
	Both sexes ³	Male ⁴	Fe- male ⁴	Both sexes ³	Male ⁴	Fe- male ⁴	Both sexes	Male	Fe- male
Arteriosclerotic and degen- erative heart disease.....	895. 4	1, 111. 5	625. 4	333. 1	441. 2	222. 6	2. 7	2. 6	2. 8
Pneumonia.....	552. 2	647. 6	419. 9	17. 6	23. 9	11. 4	31. 4	27. 1	36. 8
Vascular lesions	342. 4	372. 6	305. 2	127. 9	130. 5	125. 4	2. 7	2. 9	2. 4
Tuberculosis.....	225. 2	231. 4	149. 4	17. 3	25. 1	9. 2	13. 0	9. 2	16. 2
Malignant neoplasms.....	148. 7	171. 9	144. 5	188. 7	197. 9	181. 2	. 8	. 9	. 8
Hypertension.....	88. 5	99. 2	67. 5	61. 6	58. 1	64. 6	1. 4	1. 7	1. 0
Nephritis and nephrosis	48. 2	53. 7	41. 0	17. 4	18. 7	16. 1	2. 8	2. 9	2. 5
Suicide and self-inflicted in- jury.....	24. 7	28. 2	21. 5	15. 0	23. 6	6. 4	1. 6	1. 2	3. 3
Accidental.....	22. 1	22. 2	21. 8	72. 7	103. 9	41. 3	. 3	. 2	. 5
Cirrhosis of liver.....	12. 2	8. 1	16. 8	13. 5	17. 3	9. 6	. 9	. 5	1. 8
Syphilis.....	10. 0	15. 2	5. 1	5. 1	7. 6	2. 6	2. 0	2. 0	2. 0
Diabetes mellitus	5. 5	4. 1	6. 7	27. 8	21. 7	34. 0	. 2	. 2	. 2

¹ See table 6 for full title of cause. ² Michigan 1940 population used as standard. ³ Rates standardized for age and sex. ⁴ Rates standardized for age.

The mortality rate for malignant neoplasms was generally higher in the hospitals than in the general communities, but the difference was not particularly remarkable. For example, the rate differential was 339.1 to 202.0 in 1950 and 368.7 to 222.2 in 1954. It is noted that while more men than women were dying from cancer in the general population during the entire quinquennium, the opposite pattern was developing toward the end of the period in the hospital population where female patients finally exceeded male patients in mortality rates from this disease. This increase in the importance of cancer as a cause of death among female patients seems worth special attention. The death rate for women in the 35-64 age group decreased fairly steadily in general communities, but rose rapidly in the mental hospitals' female population. In the general population there was an extraordinarily high cancer mortality rate for the aged group. It should be noted that the death rate for the general population not only exceeded that for the patient population, but also increased rapidly during the course of 5 years.

Diabetes mellitus is the one cause of death studied which was considerably more prevalent in the general population than inside the hospitals. For instance, the rates were 34.0 and 10.8 respectively in 1950. This difference was clearer and more consistent for the old age group. However, during the period of the study, the hospital death rate from diabetes showed a gradual rise from 10.8 to 35.4 which seems to be indicative of an increasing importance of this disease among mental patients. This increasing trend was almost exclusively accounted for by the female patients, particularly those in the older group.

Vascular lesions affecting the central nervous system caused a high mortality in both populations, although the mental hospitals had much higher rates than the communities, regardless of age and sex differences. During the quinquennium there was a very conspicuous rise in this disease as a cause of death in the hospital population, an increase in the rate from 656.7 to 1,146.4, but the rate remained relatively stable at the level of 150 in general communities.

Arteriosclerotic and degenerative heart disease was the most outstanding cause of death

commonly found in both populations. In 1950 the rate was 2,616.1 in hospitals and 372.1 in the general population. While there was a rising trend of the mortality from heart disease in the general population, there was a consistent and favorable decrease in the mortality from the same disease in the mental hospitals, particularly among female patients. The excess of male mortality over female mortality from heart disease was a common phenomenon. However, this characteristic was found to be much more distinct in the hospital population than in the general population.

Mortality rates from hypertension with and without heart disease were about twice as high in the hospital population as in the general community. For instance, in 1954 the rates were 116.2 and 65.9 respectively. It is notable that in the community population relatively more women than men were dying from hypertension, particularly in the older age group. In mental hospitals, on the other hand, there was a consistent and rapidly growing trend in mortality from hypertension during the first few years of the period.

It has been mentioned previously that the sharpest difference in mortality rates between the two populations was from pneumonia. On the 5-year average the rate difference was indicated by as high a ratio as 20 to well over 1,000. However, there has been a steady decline in the death rate from pneumonia in the hospital mortality tables, while the mortality in the general population has remained relatively stationary. This is probably a reflection of the improvement in the general medical care of patients in mental institutions.

Cirrhosis of liver was one of the much less important causes of death in both populations. In 1954 only 20.2 and 15.1 persons died of this disease in mental hospitals and general communities respectively. It is also indicated that neither environmental differences nor the differences in demographic characteristics seem to produce an appreciable variance in the mortality from this disease.

A steady decline in the death rate from nephritis and nephrosis was experienced both in the general population and in the mental hospitals, but this trend was much more markedly observed in the latter, where the rate changed

from 166.9 to 30.3, than in the former, where it changed only from 22.4 to 16.1.

Suicide and self-inflicted injury was a much more common cause of death in mental hospitals at the beginning of the quinquennium. The actual rate difference was 43.1 to 16.3 in 1950. However, the death rate difference became almost negligible toward the end of the period as the patient deaths from this cause gradually declined. This was almost entirely due to a decrease in suicide among male patients, in which group the death rate actually dropped to less than one-third of the 1950 record. Thus, at the end of the quinquennium, the death rate for men in the general community became considerably higher than that for men in the hospital population. Suicide and self-inflicted injury was a much more prevalent cause of death among people in the productive ages than those in other ages.

The accidental death rate was much lower in the hospital population than in the general population. In 1950, for instance, there were 26.9 per 100,000 accidental deaths in hospitals while 77.1, or three times as many, deaths per 100,000 were caused by accidents outside hospitals. However, there was a general rising trend in the mortality among patients, particularly among female patients.

Standardized Cause-Specific Rates

Having eliminated the influence of age-sex composition of a population, the standardized 5-year average rates provide a better basis for comparison of the mortality from specific causes between hospital and general populations, as well as between men and women of each population. The standardized cause-specific death rates for each of the two populations are ranked in the following order:

Hospital

- | | |
|--|--------------------------------------|
| 1. Arteriosclerotic and degenerative heart disease | 7. Nephritis and nephrosis |
| 2. Pneumonia | 8. Suicide and self-inflicted injury |
| 3. Vascular lesions | 9. Accident |
| 4. Tuberculosis | 10. Cirrhosis of liver |
| 5. Malignant neoplasms | 11. Syphilis |
| 6. Hypertension | 12. Diabetes mellitus |

General

- | | |
|--|---------------------------------------|
| 1. Arteriosclerotic and degenerative heart disease | 7. Pneumonia |
| 2. Malignant neoplasms | 8. Nephritis and nephrosis |
| 3. Vascular lesions | 9. Tuberculosis |
| 4. Accident | 10. Suicide and self-inflicted injury |
| 5. Hypertension | 11. Cirrhosis of liver |
| 6. Diabetes mellitus | 12. Syphilis |

The death rates from two different causes, pneumonia and tuberculosis, showed a marked difference between the two populations. The age-sex adjusted rate from pneumonia was approximately 30 times as high in the hospital as in the general population, while the rate from tuberculosis was 13 times as high in the hospital as in the general population. The adjusted rate from heart disease, vascular lesions, hypertension, nephritis and nephrosis, suicide, and syphilis was about twice as high for the patients as for the people in the community. Conversely, cancer, accident, diabetes mellitus, and cirrhosis of liver were found to be less important among the patients.

The data further indicate that the spread between highest and lowest cause-specific death rates was much smaller for the general population than for the hospital population. The adjusted mortality rates were always higher for men than for women excluding diabetes mellitus in both places, cirrhosis of liver in the hospital, and hypertension in the community.

Rates by Psychiatric Diagnosis

Of somewhat different significance from the cause-specific death rate was the death rate as it relates to psychiatric diagnosis. The diagnosis-specific rate is measured as the number of patient deaths with a given psychiatric diagnosis per 1,000 patients with the same diagnosis. The number and percentage distribution of resident patients and deaths by diagnosis (7) and sex and the diagnosis-specific death rates for 1955 are presented in table 8. (Because of the availability of data, 1955 was used for the data analyzed in table 8. Death rates computed in this table can be treated as proportions amenable to the statistical test for the significance of the difference. However, in view of small numbers in some diagnostic categories, the sampling distribution of the difference between

Table 8. Number and percentage distribution of resident patients and deaths, by diagnosis and sex, and diagnosis-specific death rate, 1955

Diagnosis by sex	Patients		Deaths		Death rate per 1,000
	Num- ber	Per- cent ¹	Num- ber	Per- cent ¹	
<i>Both sexes</i>					
Acute brain disorders	84	0.4	11	0.8	131.0
Chronic brain disorders	2,693	13.2	209	14.3	77.6
Disorders of the senium	2,253	11.1	813	55.7	360.9
Involuntional psychoses	442	2.2	32	2.2	72.4
Manic-depressive psychoses	773	3.8	50	3.4	64.7
Schizophrenia	11,792	57.9	252	17.3	21.4
Psychoneurotic disorders	239	1.2	11	.8	46.0
Personality disorders	440	2.2	13	.9	29.5
All others	1,660	8.1	69	4.7	41.6
Total	20,376	100.0	1,460	100.0	71.7
<i>Male</i>					
Acute brain disorders	65	.7	6	.7	92.3
Chronic brain disorders	1,745	17.6	118	15.6	67.6
Disorders of the senium	1,045	10.5	409	54.2	391.4
Involuntional psychoses	134	1.4	19	2.5	141.8
Manic-depressive psychoses	267	2.7	17	2.3	63.7
Schizophrenia	5,404	54.5	134	17.7	24.8
Psychoneurotic disorders	101	1.0	6	.8	59.4
Personality disorders	316	3.2	8	1.1	25.3
All others	832	8.4	38	5.0	45.7
Total	9,909	100.0	755	100.0	76.2
<i>Female</i>					
Acute brain disorders	19	.2	5	.7	263.2
Chronic brain disorders	948	9.1	91	12.9	96.0
Disorders of the senium	1,208	11.5	404	57.3	334.4
Involuntional psychoses	308	2.9	13	1.8	42.2
Manic-depressive psychoses	506	4.8	33	4.7	65.2
Schizophrenia	6,388	61.0	118	16.7	18.5
Psychoneurotic disorders	138	1.3	5	.7	36.2
Personality disorders	124	1.2	5	.7	40.3
All others	828	7.9	31	4.4	37.4
Total	10,467	100.0	705	100.0	67.4

¹ Percentages, rounded, may not add to 100.

proportions may not approximate normality.)

Diagnostic groupings in this study were developed to provide homogeneity of categories and also to use the experience in hospitals which has indicated meaningful subgroups. Since the mortality data were not available by age and sex for each diagnosis, the following discussions are based upon the crude death rates without control for the age-sex variation of the patient groups with different diagnoses.

More than 80 percent of the 20,376 patients residing in State mental hospitals in 1955 were included in three diagnostic classes, with 57.9 percent diagnosed as schizophrenic; 13.2 percent diagnosed as chronic brain disorders; and 11.1 percent diagnosed as disorders of the senium. The degree of concentration just mentioned was found to be somewhat higher among male patients than among female patients, although a considerably larger proportion, 61.0 percent, of female patients than of male patients, 54.5 percent, belonged to the schizophrenic group. There were about twice as many males as females with chronic brain disorders.

The pattern of diagnosis-specific death rates appeared to be quite different from that of cause-specific death rates. First, the range between highest and lowest rates by diagnosis was found to be much smaller than that by cause of death. Second, resident patients can easily be dichotomized, in terms of crude death rate, into the high- and the low-risk groups respectively. The high-risk groups for both sexes consisted of those with disorders of the senium and those with acute brain disorders. This was also true when female patients were considered individually, but when male patients were so considered, those with disorders of the senium and those with involuntional psychoses actually constituted the high-risk group. Within the low-risk group the variation of death rate was not great.

The highest death rate, 360.9 per 1,000 was found for the group of patients having a diagnosis commonly associated with advanced age, that is, disorders of the senium. The second highest, 131.0 per 1,000, was for the group with acute brain disorders, but when male patients were considered separately the group with involuntional psychoses ranked second highest,

Table 9. Mean age of resident patients, by diagnosis and sex, 1955

Diagnosis	Mean age and sex		
	Both sexes	Male	Female
Acute brain disorder.....	56.3	56.5	55.8
Chronic brain disorder.....	54.3	54.5	54.0
Disorders of the senium.....	75.4	73.8	76.8
Involucional psychoses.....	63.2	64.5	62.6
Manic-depressive psychoses.....	62.0	62.5	61.7
Schizophrenia.....	49.1	48.4	49.6
Psychoneurotic disorders.....	51.4	45.2	55.8
Personality disorders.....	44.8	44.8	44.8
All others.....	53.8	52.4	55.3
Total.....	56.7	55.8	57.4

141.8 per 1,000. For other diagnostic groups used in this analysis the rates were always less than 100 and ranked in the following order: chronic brain disorders, involucional psychoses, manic-depressive psychoses, psychoneurotic disorders, all others, personality disorders, and schizophrenia. The psychotic group with relatively low death rates were those with the so-called functional disorders without known physical basis. For example, the schizophrenic group had the lowest death rate, 21.4 per 1,000, regardless of sex difference. As against the usual pattern, relatively more female patients than male patients diagnosed as either chronic

brain disorders, manic-depressive psychoses, or personality disorders died in 1955.

Physical Condition, Age, and Diagnosis

While the physical condition of a patient on admission cannot be assumed to remain constant during hospitalization, it still is the best available estimate of the importance of physical explanations for the generally high mortality rate of psychiatric patients. The information is provided by the admitting physician and is classified as "good," "fair," "poor," or "critical."

The mean age of resident patients by diagnosis and sex, and the physical condition of patients on admission by diagnosis, were examined together to account for some of the basic differences in the diagnosis-specific mortality rate (tables 9 and 10). Spearman's rank order correlation (8) between diagnosis-specific death rate and percentage of patients with "good" physical condition on admission substantiates a significant relationship between them ($r_s = -0.900$; $P < 0.001$). That is, the greater the percentage of patients with "good" physical condition the lower the death rate. An extremely high death rate for the senile psychoses was well supported by the fact that not only the mean age of this group was high but also a large proportion of the group had a "subnormal" physical condition on admission

Table 10. Percentage distribution of all admissions and admissions for selected age group, by diagnosis, and percentage distribution of admissions for selected disorder, by patients' physical condition, 1955

Diagnosis	All ages ¹	Age group			Physical condition				
		20-44	45-64	65 and over	Total ¹	Good	Fair	Poor	Critical
Acute brain disorders.....	1.8	2.3	2.2	0.5	100.0	58.4	28.6	10.4	2.6
Chronic brain disorders.....	10.0	7.0	18.1	6.8	100.0	29.4	47.7	18.2	4.7
Disorders of the senium.....	20.4	.1	10.6	80.4	100.0	14.8	35.2	38.9	11.1
Involucional psychoses.....	3.7	.3	12.0	1.6	100.0	61.5	33.5	3.7	1.3
Manic-depressive psychoses.....	4.0	2.6	7.5	3.4	100.0	53.8	40.4	5.3	.5
Schizophrenia.....	42.2	65.2	32.8	4.5	100.0	74.5	21.4	3.6	.5
Psychoneurotic disorders.....	4.5	5.8	4.0	1.7	100.0	70.8	25.1	4.1	0
Personality disorders.....	11.6	14.4	11.1	1.0	100.0	75.5	22.1	2.0	.4
All other.....	1.8	2.3	1.7	.1	100.0	71.4	19.5	7.8	1.3
Total.....	100.0	100.0	100.0	100.0	100.0	56.1	28.4	12.4	3.1

¹ Including 19 and under.

NOTE: Because of the availability of data, 1955 was used for analysis.

identified as either "fair," "poor," or "critical." For example, 11.1 percent of those with disorders of the senium were identified as "critical" at the time of admission to the hospitals.

In contrast, the lower mortality rates for the schizophrenic group and for the group with personality disorders can be explained by the low mean age of each group and also by "good" physical condition of those patients on admission. The relatively high death rates in the diagnostic categories of acute brain disorders, chronic brain disorders, disorders of the senium, involutional psychoses, and manic-depressive psychoses coincide remarkably with the fact that each of these groups had a relatively high mean age as well as a relatively large proportion with "subnormal" physical condition at the time of admission.

It should be noted that as high as 43.9 percent of all patients admitted to State mental hospitals in 1955 were physically identified as either "fair," "poor," or "critical." This seems to be one of the most significant factors explaining the high mortality rate in mental hospitals as compared with the low mortality rate prevalent in the general communities.

The physical condition of the patient on admission was found to be closely related to the patient's age on admission. That is, the higher the age of the patient group the smaller the proportion having "good" physical condition. Spearman's rank correlation coefficient ($r_s = -0.835$; $0.01 > P > 0.001$) supports this generalization. The patient group between the ages of 20 and 44 at the time of admission had 75.7 percent classified as in "good" physical condition while only 17.3 percent of the patients aged 65 and over at the time of admission were so classified.

Summary and Conclusion

The interpretations and generalizations presented in the present study are based on data collected in Michigan for the 1950-54 period. The following conclusions appear to be of significance.

1. The mental hospital population was over-represented by the middle and old age groups as compared with the State population.

2. The hospital mortality rate was more var-

iable and unstable than the general mortality rate.

3. In terms of crude rate the overall hospital mortality was 6.8 times as high as the overall general mortality.

4. When the rates were adjusted for age and sex, the overall hospital mortality was 3.6 times as high as the overall general mortality.

5. The quinquennial decline in the death rate was much greater in the hospital population than in the general population, thus narrowing the rate discrepancy between the two.

6. The quinquennial decline in the death rate was much greater among older people, particularly among older men, in both populations.

7. The sex difference in death rate was much greater in the hospital population than in the general population.

8. The hospital death rate was always higher than the general death rate in each age-sex specific group.

9. The relative importance of each of the 12 leading causes of death was manifested differently in the two different populations. The two most frequent causes of death in the hospital population were arteriosclerotic and degenerative heart disease and pneumonia, while those in the general population were arteriosclerotic and degenerative heart disease and malignant neoplasms.

10. The age-sex adjusted mortality rates from pneumonia and tuberculosis were approximately 30 times and 13 times as high in the hospital as in the general population respectively.

11. Malignant neoplasms, accidents, cirrhosis of liver, and diabetes mellitus were found to be less important for the hospital population than for the general population.

12. The high mortality group of the patients consisted of those with senile psychoses and those with acute brain disorders.

13. The psychotic group with relatively low death rates were those with functional disorders such as schizophrenia.

14. A statistical analysis substantiated a consistent, positive relationship among death rate, patient age, and the proportion of patients with "subnormal" physical condition on admission to the hospital.

Although the present investigation is largely descriptive in nature, it is hoped that the results

will have not only heuristic value but will also be productive of a series of hypotheses in regard to the dynamics of differential mortality among hospitalized psychiatric patients.

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DOCUMENTATION NOTE

An additional table showing the cause-specific death rate per 100,000 for hospital and general populations, by sex, for the 5 years 1950-54, has been deposited as document No. 5565 with the American Documentation Institute Auxiliary Publications Project, Photoduplication Service, Library of Congress, Washington 25, D. C. A photoprint may be obtained by remitting \$1.25; a 35-mm. microfilm copy by remitting \$1.25. Advance payment is required. Cite document number. Make check or money order payable to Chief, Photoduplication Service, Library of Congress.

Syphilis Serology Courses

Eight laboratory courses will be offered at the Venereal Disease Research Laboratory of the Public Health Service in Chamblee, Ga., September 1958 through May 1959, according to the following schedule:

Serology of syphilis. September 8-19; December 1-12; February 9-20; April 6-17.

Tests for syphilis using treponemal antigens. October 6-17; March 9-20.

Fluorescent antibody techniques in the diagnosis of the venereal diseases. March 23-27.

Control of syphilis serology by the regional laboratory. May 4-15.

The four refresher courses in serology of syphilis will consist of lecture, demonstration, and participation periods covering the most widely used nontreponemal procedures in addition to supplemental methods. Special reference will be made to the latest developments, such as the Kolmer test with Reiter protein antigen, the TPCF test, and the use of a stabilized antigen emulsion in the VDRL tests.

The two courses in the treponemal antigen tests for syphilis are designed for senior staff members. The course in fluorescent antibody

techniques will cover the performance of the fluorescent treponemal antibody test, with instruction in the use of ultraviolet microscope assemblies. Instruction in the identification of *Neisseria gonorrhea* and *Hemophilus ducreyi* will include antibody preparation, fluorescein-labeling, and preservation. The course in control of syphilis serology by the regional laboratory, designed for laboratory directors and senior staff members, includes review of national and statewide serologic evaluation programs, laboratory visits, and field workshop procedures, together with discussion and demonstration of new procedures.

Applications must be approved by a State health officer or State laboratory director, by the medical officer in charge or a Federal agency, or by the organization sponsoring applicants from other countries. Application forms may be obtained from: Director, Venereal Disease Research Laboratory, Venereal Disease Branch, Communicable Disease Center, Public Health Service, P. O. Box 185, Chamblee, Ga.

publications

The Nurse in the U. S. Public Health Service

PHS Publication No. 361. Revised September 1957. 24 pages, plus supplement; illustrated.

The story of career opportunities for both clinical and public health nurses in the various nursing programs of the Public Health Service is brought up to date. The booklet describes the work of nurses in Service hospitals, at the Clinical Center of the National Institutes of Health, in Indian health and international health programs, in field research and investigation, in work with States, and in nursing resources activities.

The two personnel systems of the Service, Civil Service and Commissioned Corps, are explained, and methods of applying for various assignments are outlined. A supplement lists requirements for applicants and other detailed employment information.

Patients in Public Hospitals for the Care of the Mentally Ill, 1956-1957

PHS Publication. Mental Health Statistics. Current Reports Series MHB-H-3. December 1957. 8 pages. 5 cents.

Designed to permit early publication of selected statistics for public mental hospital systems in the United States, this report replaces the publications entitled "Patients in Public Hospitals for the Prolonged Care of the Mentally Ill," formerly published in this series, and "Mental Patient Data for Fiscal Year," previously presented in *Public Health Reports*.

Data from two sources are combined. Statistics for 1956 are based on preliminary tabulations of schedules submitted for the 1956 census of mental patients. Those for 1957 are based on estimates obtained in

a special survey of public mental hospitals conducted shortly after the close of the fiscal year. Selected items of patient movement, number of employees at end of year, and maintenance expenditures are shown for each State, with a separation into "all public hospitals" and "prolonged care" for those States having short-term psychopathic hospitals.

National Library of Medicine

PHS Publication No. 507. Revised February 1958. 13 pages.

Library hours, loan procedures, photographic and reference services, translators, history of medicine division, art section, medical motion picture collection, and publications of the National Library of Medicine are described in this booklet.

Uniform Definitions of Home Accidents

PHS Publication No. 577. 1958. 15 pages. 30 cents.

Designed to provide precise meanings of terms in the home accident field, this manual of definitions should prove useful to all personnel engaged in home accident reporting or home accident prevention programs.

To be listed a term must be pertinent to home accident prevention; it must have a special connotation in home accident prevention or a related field (medicine, statistical analysis, engineering, and so forth); and, it should, if possible, indicate a measurable variable. Certain common terms which are subject to misinterpretation are included, but clearly defined common or nontechnical terms found in the average dictionary are omitted.

The definitions were developed by the Conference on Uniform Defini-

tions of Home Accidents that met in Chicago, April 1957, under the sponsorship of the Public Health Service, the American Public Health Association, and the National Safety Council.

Taking Care of Diabetes

PHS Publication No. 567. 1958. 32 pages; illustrated. 20 cents.

Written especially to help the diabetic person and his family develop a better understanding of the disease and its control, this booklet presents salient facts about the physiology of diabetes and the relation of food, exercise, and insulin to its control.

The patient is shown how he can have a wide variety of foods by using the meal plan suggested by his doctor in conjunction with six food exchange lists. The technique used in administering insulin, how to take proper care of injection equipment, and Benedict's test for urine sugar are described.

Emphasis is given to the importance of recognizing symptoms of insulin reaction and onset of diabetic coma as well as the need for the diabetic patient to take proper care of his feet.

Manual for Nutrition Surveys

Interdepartmental Committee on Nutrition for National Defense. 1957. 160 pages. \$1.50.

Methods for conducting nutrition surveys and appraising the nutritional status of a population are presented in this reference and guide. Although the manual is designed primarily for surveys of military forces, the basic approach and methodology are applicable to civilian populations.

The manual is intended to establish uniform methods in collecting data, to provide a reference to insure maximum coverage of the essential facts, and to serve as a guide for interpretation of dietary, biochemical, and clinical data. It also offers guidelines in defining the duties of

various team members and for training local personnel.

The list of necessary supplies and equipment and the chapter on sampling are applicable equally to a single nutrition survey or a permanent nutrition service.

State Personnel in Official and Voluntary Agencies Concerned With Agricultural Migrants

PHS Publication (unnumbered). 1958. 14 pages.

Persons in selected official and voluntary agencies in the States who are officially designated to be contacted on questions regarding agricultural migrants are identified. Representatives of State departments of health and education, the Farm Placement Service of the U. S. Department of Labor, and the Migrant Ministry of the Home Missions Division of the National Council of Churches are listed along with persons named by the governors as liaison with the President's Committee on Migratory Labor in States where there is no official committee.

Copies can be obtained from: Division of General Health Services, Bureau of State Services, Public Health Service, Washington 25, D. C.

Public Exposure to Ionizing Radiations

What Public Health Personnel Need to Know

American Public Health Association. 1958. 55 pages; glossary. \$1.35; orders for 25 or more at a discount.

This pamphlet aims to provide public health employees with simple concepts basic to a radiological health program. The text presents the issues, in perspective. Although it does not deal with physics or with the precise definition or measurement of radiations, it describes the phenomena of radiations and their probable public health effects. Major sources of radiation of concern to public health workers are discussed

as to their benefits and hazards, present and future.

The pamphlet was prepared by a committee of the American Public Health Association with advice and technical assistance from employees of the Public Health Service. Orders should be placed with the American Public Health Association, 1790 Broadway, New York 19, N. Y.

Research and Education in Rheumatic Diseases

Transactions of the Second National Conference

Arthritis and Rheumatism Foundation and the National Institute of Arthritis and Metabolic Diseases of the Public Health Service. 1957. 156 pages.

Texts of papers presented at the conference are assembled in this book under three headings: basic disciplines and promising pathways in research in rheumatic diseases, support currently available for research and training in rheumatic diseases, and the United States Public Health Service graduate training program in arthritis.

Distribution of the publication, now completed, is limited to members of the participating associations, medical libraries, medical schools, and a selected list of rheumatologists. Inquiries concerning availability should be addressed to the Information Office, National Institute of Arthritis and Metabolic Diseases, Public Health Service, Bethesda 14, Md.

Health Statistics From the U. S. National Health Survey

Origin and Program

PHS Publication No. 584-A1. 1958. 36 pages. 30 cents.

Background information on the U. S. National Health Survey, including history, need for health statistics, policies, and program, is presented in this booklet. It is the first

of a series (series A) covering technical and methodological matters relating to the survey.

Appendixes contain the text of the National Health Survey Act (Public Law 652, 84th Congress) and a reprint of recommendations for collection of health data of a subcommittee of the U. S. National Committee on Vital and Health Statistics (PHS Publication No. 333, 1953).

Health Statistics From the U. S. National Health Survey

Preliminary Report on Number of Persons Injured, United States, July-December 1957

PHS Publication No. 584-B3. 1958. 32 pages. 30 cents.

Persons sustaining injuries that caused restriction of their usual activities for at least a day or who were medically attended are included in the estimates. The report contains 26 detailed tables, text tables, and charts presenting breakdowns by age, sex, urban-rural residence, and class of accident. Data are based on nationwide household interviews of a representative sample of the population.

Appendixes provide technical notes on methods and definitions.

Digest of Prepaid Dental Care Plans, 1958

PHS Publication No. 585. 1958. By Walter J. Pelton and Richard W. Bowman. 41 pages.

All known prepaid dental care plans operating in the United States are listed by name, with address, sponsorship, date established, geographic area served, eligibility requirements, and size of enrollment. Information on methods of operation and types of benefits offered is also included.

The plans are grouped into two major categories, plans with regular benefits and those with limited benefits, and are subdivided into four groups: communitywide, union spon-

sorship, employer-employee sponsorship, and fraternal organization sponsorship. The complete dental fee schedules of four of the most comprehensive plans are reproduced in the appendix.

Tuberculosis Beds in Hospitals and Sanatoria, May 1, 1957

PHS Publication No. 518. 1958. By Stanley Glaser and Josephine Johnston. 41 pages. 30 cents.

A listing by State and city, as well as alphabetically, of hospitals and sanatoria in the United States and Territories with five or more beds available for treating patients with tuberculosis is provided. Included are all State, local, private, and Federal institutions except Federal mental and penal institutions. Type of ownership is specified.

Homemaker and Related Services

A Directory of Agencies in the United States

PHS Publication No. 598. 1958. 75 pages.

Name, location, telephone number, type of agency, area served, kind of service provided, year established, number of homemakers employed, and number of families served during a 1-week period are listed.

The directory was compiled from a nationwide survey of homemaker services by the Public Health Service in cooperation with the Children's Bureau and the Bureau of Public Assistance, Social Security Administration.

Strike Back at Stroke

PHS Publication No. 596. 1958. 37 pages; illustrated. 40 cents.

Step-by-step instructions and illustrations are given for 21 therapeutic exercises developed by experts in the field of medical rehabilitative therapy. The booklet also

contains information on how to fix the bed for the patient, how to place the patient in bed, and what to do if the patient cannot speak.

Designed to make it easier for the doctor to show what can be done for and by the stroke victim at home to help minimize the disability that usually follows a stroke, the manual even contains a prescription blank printed below each exercise so that the doctor can specify the frequency and duration of selected exercises.

The Vending of Food and Beverages

PHS Publication No. 546. 1957. 18 pages. 15 cents.

Intended for adoption by municipalities and States, the suggested sanitation ordinance and code contains the recommendations of the Public Health Service. It is published for the guidance of jurisdictions desiring a uniform law based on the best information currently available. The format of the ordinance permits flexibility in adoption or enactment.

The recommendations are based on field studies of current practices in vending machine design, construction, and operation, and a review of existing State and local regulations. They were developed at the request of State and local health authorities and the vending machine industry.

Proceedings of Symposium on Coccidioidomycosis, 1957

PHS Publication No. 575. 1957. 197 pages; illustrated.

Currently available information on the epidemiology, ecology, immunology, pathology, diagnosis, and treatment of coccidioidomycosis, together with the most recent advances in research, is comprehensively reviewed. This material is published for the benefit of investigators everywhere who are attempting to overcome the difficulties in diagnosing, controlling, and treating this disease.

Directory of Medical and Biological Research Institutes of the U. S. S. R.

PHS Publication No. 587. 1958. 340 pages.

More than 700 biological and medical research institutes in the U. S. S. R., with their subdivisions and laboratories, are listed in this directory. Arrangement is geographic, with a subject index. A name index includes more than 1,500 Russian scientists.

The directory is intended as a guide not only for those planning scientific visits or correspondence but also for those studying Soviet medical research.

Extent of Cancer Illness in the United States

PHS Publication No. 547. 1958. 23 pages. 25 cents.

Trends and variation in cancer mortality and incidence, some aspects of diagnosis and treatment, and survival prospects for cancer patients are covered in this well-documented, statistical study of cancer. The booklet is comprised of 31 questions and answers together with 22 charts and 9 tables. It is directed to persons concerned with the course of cancer in individual patients or with its impact on larger population groups.

This section carries announcements of new publications prepared by the Public Health Service and of selected publications prepared by other Federal agencies.

Unless otherwise indicated, publications for which prices are quoted are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Orders should be accompanied by cash, check, or money order and should fully identify the publication. Public Health Service publications which do not carry price quotations, as well as single sample copies of those for which prices are shown, can be obtained without charge from the Public Inquiries Branch, Office of Information, Public Health Service, Washington 25, D. C.

The Public Health Service does not supply publications other than its own.
